THE

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ELECTRICAL FRAUDS.

A TITLE like the one we have adopted, upon which to make a few comments, might be taken to apply either to bogus electrical apparatus, to the vendors of such appliances, or to both. It was suggested by the paper read by Mr. Knudson before the New York Electrical Society on December 30th last, at Columbia College, which he entitled "Frauds in the Electrical Business."

The author only touched upon the various branches of electricity in which impostors have left their tracks, and related several instances as they have come under his notice during the past few years. It was to be understood that in speaking of impostors or "fakirs," he meant only those who, knowing an invention to be worthless, or of but little value, will attempt, by false statements, to induce people to put money into the same, and he excluded those inventors who, honestly believing they have discovered something new and original, seek to interest capital, although their scheme may finally prove to be impracticable or previously patented.

Mr. Knudson cites several examples of the primary battery fraud, but his experience does not appear to have been so extensive as has our own on this side of the water. Indeed, the primary battery cell has never flourished as a hardy annual in England; for, before the pockets of the British public were fleeced, the technical journals have generally spoilt the main chance to both inventor and promoter. Many are the attempts which have been made to "boom" the electric-light-for-nothing-bye-product-producing primary battery; but so far as we can call to mind, only a few well-to-do pigeons have been plucked, and these only to an extent which left them little the worse for the operation. It could scarcely be otherwise here, for on points like these, the public procure expert testimony before matters have assumed a very serious turn; and in nine cases out of ten, the ingenious gentleman who, "after years of study, has succeeded in producing, &c.," retires into obscurity until the *exposé* has blown over, when he emerges from the involuntary hermit's life he has been leading, and once again inveigles an innocent to back him up with the needful.

Mr. Knudson then enumerates a few telephonic "fakes" which came under his notice, and which were perpetrated with a view of getting outside the Bell monopoly, but any special mention of these, or of "acoustic" telephone swindles, would not excite any particular interest amongst English readers.

When, however, our author gets into the region of electric belts, hair brushes, corsets, the electric garter, guaranteed to give a more shapely appearance to the lower extremities of the female form divine, &c., he immediately trenches upon the "frauds in the electrical business," which in this country, as well as in the States, call for strict legislative measures to suppress, or, at least, control. It

is here that the public is absolutely at the mercy of the audacious quack, who, medically advised by, perhaps, a person who assumes a degree to which he has no legal right, and legally instructed how to sail very close to the wind and yet to keep without the pale of the law, can fleece his victims with impunity, and also command hundreds of testimonials extolling the efficacy of his treatment, the patients little knowing that faith and flannel, and not electricity, is responsible for any benefits they may have derived. Notwithstanding the much-advertised testimony of grateful clients, we undertake to say that not one of these pests to society could prove in a court of law that electricity, *per se*, had anything whatever to do with a so-called cure, and we assert equally positively that it would be an easy matter to prove the reverse; it is a pity, therefore, that some individual—and there are many about—who knows that he has been led into purchasing useless articles at exorbitant prices and under false pretences, has not the courage to carry his case into court, and not allow it to be compromised, as is nearly always the result directly these charlatans get scent of a probable law-suit.

Mr. Knudson wonders that the electrical journals have not been more outspoken in showing up these frauds upon the public; doubtless he is referring simply to the technical press of his own country, for here the ELECTRICAL REVIEW has preached a crusade for years past. Other technical and medical journals have, at long intervals, fitfully and feebly supported us, but neither the wonder of Mr. Knudson nor our own writings will stamp out the blot. The electropathic business is kept flourishing by the false and fulsome articles inserted in daily and weekly newspapers of ostensibly the highest respectability, and weekly and monthly magazines which influence the public in their home life. Only at Christmastide did we come across a description of a visit to a well known electropathic establishment which, if it did not assert that the apparatus there to be obtained cured every ill to which flesh is heir, left it the benefit of the doubt. The article, in a fashionable West End weekly, was written by the daughter of a gentleman for whom we entertain a high regard; she, a most estimable lady, being unhappily devoid of anything approaching a technical education, easily fell into the well managed and elegantly prepared trap with the result above stated.

Take the still more glaring example of the *Standard* in describing the exhibits of the Crystal Palace Exhibition; and in ninety-nine cases out of every hundred we venture to say that the ends of the philanthropic vendor of electro-medical appliances are obtained in like manner.

No! Mr. Knudson, the public *does not* look to electrical papers as a source of information on matters of this kind, notwithstanding that these journals are not handicapped by being paid for fat advertisements, and, so long as the newspaper press goes on disseminating misleading literature of the kind, so long will the "frauds in the electrical business" flourish. Is it likely that the *Daily Telegraph*, the *Standard*, even the *Times* itself, would allow a writer to publish a tirade against electropathic appliances in their reading pages when every now and again a whole page advertisement is taken up in belauding them? No! a different means must be adopted than any hitherto employed to scotch the electropathic snake, and as inserting the thin end of the wedge, why does not the Institution of Electrical Engineers ask one of its members to prepare and read a paper similar in scope to that of Mr. Knudson's, and dealing with the frauds now being perpetrated in London alone.

The proceedings of important societies are generally noticed by the London press, and the Institution, by showing that it had no sympathy with mountebanks, would be doing a public good, and Professor Ayrton's year of office would be made memorable in its annals.

MAGNETIC OXIDE OF IRON AS AN ANTI-CORROSIVE COVERING FOR IRON-WORK.

THE chemistry of decay is attracting more of the attention it deserves to-day than it has ever done, and practical engineers are beginning to recognise the importance of possessing a thorough knowledge of the conditions which govern the corrosion of the structures which they erect.

When wrought iron came into use as a material for structural purposes, its elastic resistance commanded so much attention that its liability to rust was overlooked, but it must be seriously taken into all calculations now, and for obvious reasons.

A writer in the *Practical Engineer* has recently been discussing the phenomena of corrosion, especially in its relation to wrought iron. By using chemical arguments he arrives at the conclusion that we must look to oils to protect the iron, and not to such metallic oxides as may be able to yield up some of their oxygen to the metal which they are intended to preserve.

Metallic oxides, however, are necessary to give the oils a "body," but the only oxides that may safely be used are stable protoxides, which have no tendency to give up their oxygen unless electrical action sets in, which is exceedingly unlikely in connection with paints.

Of the oxides of iron there is one, namely, the triferric tetroxide, $Fe\,O\cdot Fe_2\,O_3$ or $F_3\,O_4$, commonly called the magnetic oxide of iron, which is one of the most valuable ores of iron. In its natural state it is called magnetite, and is met with chiefly in the northern parts of Europe, in Siberia and North America, although it is also found to some extent in Southern Europe, Mexico, &c. Magnetite is the chief constituent of "loadstone." It has a black colour with a tinge of brown, or even green. It is formed artificially when iron is heated to redness in steam, or when it is burned in oxygen gas and by other chemical processes.

Since magnetic oxide of iron is very stable, it is an excellent substance for covering iron surfaces; it is so protective that corrosive action cannot penetrate.

For some years past paint has been made of the magnetic oxide of iron, but it is really amusing that some who sold it claimed its *magnetic powers of adhesion* as an advantage in point of durability. Magnetic oxide of iron certainly can be picked up by a magnet, but we do not find that it exhibits any such qualities as have been referred to.

There is a system of protecting iron based upon the formation of a coat of magnetic oxide upon its surface, which is probably the most perfect application of the principle yet known, but it cannot unfortunately be applied to large structures; and it is for large structures that we require an

absolutely perfect protective covering—one that shall be, if not permanent, at least reliable for many years.

There is room for profitable research in this direction. There is no doubt that magnetic oxide of iron in a suitable vehicle would form the basis of a really protective covering for wrought iron and steel. This vehicle has not yet been found; but we can assure anyone who will produce a reliable protective covering suitable to the requirements of the modern engineer that he will possess a "good thing" for which he will have no difficulty in finding a good market.

Central Station Practice.

Our young contemporary, *Lightning*, in a recent issue takes exception to our article on central station practice, on the grounds that the use of dynamos driven direct by high speed engines is not sufficiently universal to be considered as representative of English practice. He states that the Deptford station of the London Electric Supply Corporation, the House to House Company's station, one of the Metropolitan Company's stations at Sardinia Street, the stations at Glasgow, Bath, Newcastle, Taunton, Exeter, Brighton, Eastbourne, Dublin and Bournemouth do not conform to the conditions stated in the "ELECTRICAL REVIEW" to be distinctive of English practice. The instances, however, quoted by our critic, instead of contravening our views tend to strengthen them. The present time is a very convenient one for our readers to investigate this subject for themselves. If they turn to the electric light statistics recently published by ourselves and several of our contemporaries, they will see that if we take the plant now at work in the central stations in the United Kingdom which have 300 H.P. and upwards in position, the total H.P. now in use is just under 33,000. Of this 22,300, or about 68 per cent. of the whole follows what we have called the English practice, that is to say, Willans engines are used driving various types of dynamos coupled direct to them. Of the remainder we find about 4,800 H.P., or 14 per cent. in the Deptford station, which can hardly in its present condition be called a representative one. About 2,600 H.P. or 8 per cent. in the Sardinia Street station of the Metropolitan Supply Company, which is of American design, about 500 H.P., say 1½ per cent. in the shape of Parsons turbo-generators at Newcastle, and in the remaining stations above 300 H.P. we find a total of about 2,800 H.P., which is 8½ per cent. of the whole (33,000). These last named stations, the largest of which is that of the House to House Company at West Brompton, are all of them situated in places where engine room space is not valuable. Whatever may be the opinion of our critic on its merits it will be seen that the H.P. installed, following the English practice, is five times as great as any other arrangement, and at present it includes nearly all the largest and most successful central stations.

The Potential of the Atmosphere.

EVERY student of electricity is probably familiar with the classic experiments which were conducted by Benjamin Franklin in 1749. To this pioneer of electricity belongs the credit of putting the two phenomena of lightning and the electric spark beyond question, and proving experimentally that the clouds in a thunderstorm are charged with electricity. The "kite experiments" of Franklin have often been repeated, but we are not aware that any important quantitative measurements of the electrical potential of the atmosphere have ever been attempted until quite recently. In an article in the *American Meteorological Journal* by A. McAdie, the writer, after giving various details concerning the *modus operandi* adopted by Franklin in his investigation, goes on to describe similar experiments recently carried on at the Blue Hill Observatory, near Boston. In this investigation the electrical potential of the atmosphere was measured at every step by means of an electrometer. The experimental kite was sent up on several days, and at a height of 1,000 feet sparks over ⅛th of an inch in length were obtained. In "thunder weather" the arrangement of kite and electrometer was found sufficiently delicate to foretell when a flash of lightning was about to occur; this was indicated by abnormal movements of the stream of water from the electrometer. The kite system has also been recently used for comparing the wind velocity with that of the clouds, in determining the height of clouds, for making panoramic photographs, and also for estimating the vertical extension of warm air currents.

A New Electrolytic Process for Estimating Aluminium in Iron and Steel.

NO method gives satisfactory results in determining the aluminium in the modern alloys of this metal with iron which stops short of the isolation of it; in fact nothing short of isolation can properly prove its presence, and this is become daily of more importance. But Messrs. T. M. Drown and A. G. McKenna have recently worked out an excellent process which depends upon electrolysis and which, apart from its practical value is worth a passing notice from any electrician who makes a speciality of what we may term the electrolytic branch of our science. About 5 to 10 grammes of the sample of iron or steel is dissolved in sulphuric acid, and the solution is then heated until white fumes of sulphuric anhydride begin to come off. Boiling water is added to dissolve the iron salt, and the liquid filtered off from the silica and carbon, which are washed with acidified water. The filtrate is nearly neutralised with ammonia, and, if necessary, diluted to 300—500 cc. The beaker in which the electrolysis is to be made contains from 500 to 1,000 grammes of mercury which constitutes the cathode. It is connected with the battery or dynamo current in such a manner that about two ampères may pass through the solution over night, which is best accomplished by using three lamps of 32 candle-power, arranged in parallel on an Edison circuit. After as far as possible neutralising the acid which has been set free, the electrolysis is continued until the liquid gives no reaction for iron. It generally turns reddish-brown from the formation of permanganic acid. When all the iron has amalgamated, the liquid is removed by means of a pipette, while the current is still passing and the mercury is repeatedly washed. The platinum anode, which will generally be coated with manganese dioxide, is now taken out, and the mercury again washed with water until the last traces of solution have been removed from it. After filtering to remove any suspended manganese dioxide, excess of sodium phosphate is added, and also 10 grammes of sodium acetate. After boiling for at least 40 minutes the aluminium phosphate is collected, washed, ignited, and weighed. The true formula is $7\ Al_2\ O_3$, $6\ P_2\ O_5$. In case of doubt, the phosphate may be fused with potassium hydrogen sulphate, and the solution once more submitted to electrolysis; but this is rarely necessary.

Elmore Copper.

THE letter in our last issue, signed "Cuprum," completely confirms the strictures we made upon the tests of an Elmore electrically deposited copper tube and a brazed specimen. We said that such tests to the initiated were worthless, and we repeat it. In the face of all the directorate can say with regard to this precious metal, and with all the glowing pictures of immense dividends hanging before the noses of those to whom they appeal, the market price of Elmore shares gives a very fair estimate of the value in which they are now held.

C

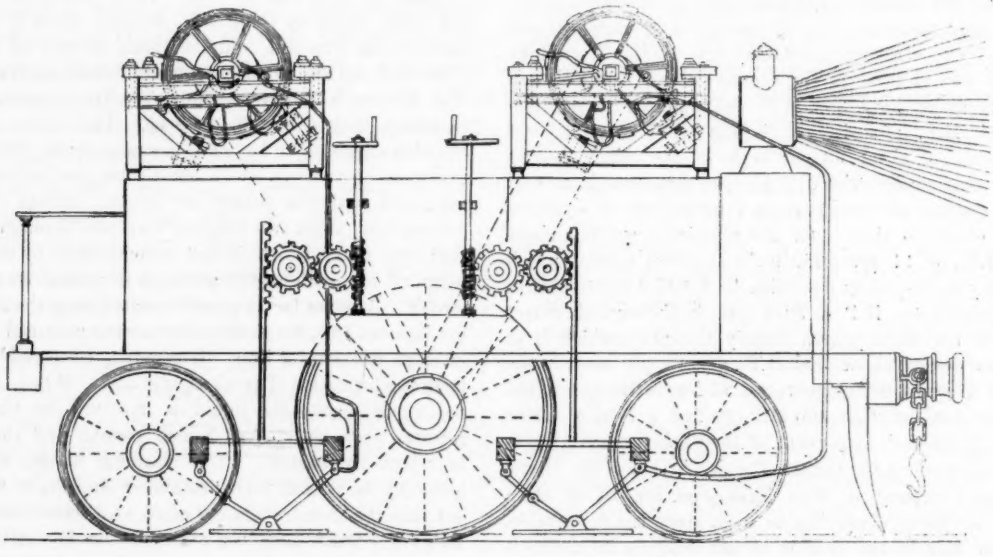
THE INVENTIONS OF HENRY PINKUS, OF PENNSYLVANIA.

He anticipates the Electric Transmission of Energy, Central Station Electric Lighting and Systems of Propelling Cars, Boats, and Agricultural Machinery by Electricity more than Fifty Years Ago.

BY A. M. TANNER.

(Concluded from page 79.)

EVERYTHING heretofore described and illustrated has reference to the operation of electric motors mounted on vehicles or locomotive engines, but the following description will show that Pinkus clearly had in view the electric transmission of energy and the distribution of electricity from a central station to stationary electric motors located in houses and factories distant from said central generating station. In the description Pinkus always speaks of the applications of electricity no matter how produced, and when he mentions magneto-electric machines to generate the electric current, he clearly had in view the mechanical generators of electricity devised by Clarke, Pixii, Von Ettinghausen, Tranchard, Boquillon, and others. These machines were all known prior to the date of Pinkus's patent, and hence the following description, found on page 17, of the patent specification should be sufficient to give to Pinkus the credit of having first proposed the electric transmission of energy. This is not saying that he carried it into practice; he only knew what might be done, and he stated it in precise language, viz. :—



"And further, having shown some of the methods by means whereof I apply electricity to impelling engines in motion from fixed points or stations. I further vary my methods as well along common roads or ways, along, over or through common roads or ways, or streets or places, and to manufacturers' houses or buildings, in a like or similar manner as I have already described them along railways or through fields, and, when so applied for the purpose as in the manner herein described for putting said impelling engines or any similar impelling engines into motion for manufacturing purposes. In making such application of said motive force or influence, I form on, along, over or through from stations as aforesaid, properly established electric metallic circuits, and to and with the said engines or any similar constructed engines, placed along or in said ways, streets, places, buildings or manufactories, I unite said engines with said metallic circuit, and the said battery or batteries at stations as aforesaid, which said battery or batteries may be placed in any convenient situations as (or ?) stations, and constitute a part of said metallic circuit or circuits, and when so established, put engine, apparatus, and machinery in motion in the manner aforesaid."

One of the claims is as follows, viz. :—

"The combinations of method and apparatus herein described for putting said engines or similar engines in operation in manufactories or places for manufacturing purposes."

To show the remarkable versatility of Pinkus as an inventor and his prophetic sight into the future, it is only necessary to give the following description of a system of central station electric lighting. It is found on page 27 of this celebrated patent, No. 8,644, viz. :—

"I further apply said combination of method and apparatus or some of them to illuminate reflectors or produce lights for lighting railways, or tunnels, or roads, or ways, or streets, or buildings, or mines. To that end I establish the metallic circuits hereinbefore described, or similar ones, communicating with batteries at similar stations or places as in the manner before described, with communicating circuits which I lead along, through, or to any desired places. At such places I construct and fix apparatus into or through which I pass the electric current or concentrate it by well-known common methods, so as on or in said apparatus I effect by well-known methods, or any variation of them, what is termed an electric glow or brush, which glow or brush or sparks or heated surfaces being placed in the focus of reflectors yields rays of light, and which reflectors being made to revolve by any of the impelling apparatus hereinbefore described, produce revolving lights, which may be used as night signals or signals in tunnels; or which glows being produced by electric effect by known methods hermetically sealed in glass globes, in which may be placed air or gases, or other substances, which may be rarified or compressed, or in which gases may be generated to increase the illuminating power of the said glow or brush, or sparks or heated surfaces, and which globes or apparatus may be placed along roads, streets, buildings, or in mines into which metallic wires as before arranged and connected and disconnected at fixed points, and to which the electric influence may be communicated from batteries or apparatus at stations aforesaid."

One of the claims of the patent reads as follows, viz. :—

"I claim the combination of method and apparatus herein described for applying said electrical currents or influence for the purposes of lighting places."

It will be observed that in the description thus given, "heated surfaces" are referred to for giving out light. In this connection it should be observed that even before the year 1840, Pinkus proposed the use of electrically heated wires or plates for the purpose of unscaling the valves of the pneumatic mains used in his atmospheric railway systems. Hence it is clearly apparent what is meant when "heated surfaces in hermetically sealed globes" are referred to. Thus Pinkus in the year 1840 already had in view a central station system of incandescent electric lighting. In this particular Pinkus even went further than his countryman Edward Augustin King, who, in the year 1845, exhibited

incandescent electric lamps in London and elsewhere, but had no idea of a central station system of lighting as proposed by Pinkus. In this connection it may be of interest to state that King, in his English patent, No. 10,919 of 1845, claims the application of a continuous metallic or carbon conductor intensely heated by the passage of a current of electricity for purposes of illumination. It will be seen that this claim is anticipated by the prior description of Pinkus. The expression "metallic wires connected and disconnected at fixed points," evidently means that the electric lights are placed in connections between the main conductors, which obviously would be a multiple arc system of electric lighting. This assertion is not a stretch of the imagination, because the same expression of "connecting the positive and negative wire conductors" as used elsewhere by Pinkus, and obviously the electric motors wherever used or referred to are in cross connections between the two main conductors. Referring again to the application of electricity as a motive power, it is necessary to state that Taylor's electric motor forms the subject matter of a British patent granted to William Hannis Taylor, of New York, November 3rd, 1839, No. 8,255. It is sufficiently indicated in the drawing of the brake operating and railway systems, and it will be seen that it resembles the well-known Froment motor of a later date. Pinkus, also, became aware of other forms of electric motors by a publication of Dr. Taylor, entitled "Steam Superseded. Account of a newly invented Magnetic Engine for the Propulsion of Locomotives, Ships, Mills, &c." Translated from the original German by Emil Stöhrer. London, 1841. It is not necessary to enter deeply into the question as to whether Pinkus could in the year 1840, or thereabouts, have worked either or all of the systems patented by him, and discussed in the present article. The self-exciting continuous dynamo machine was, of course, not in existence, but independently excited dynamo-electric generators were known,* and in France, Boquillon, a physicist of note, had even gone so far as to work six Clarke machines, either in series or in parallel, for feeding into the same work circuit, containing electro-plating vats. These experiments were performed at the Conservatoire des Arts et Métiers in Paris, and Pinkus could easily have heard of them, as he was undoubtedly in Paris in the year 1841, when his application for French patent was filed by the American Consul Brent.

"Ear marks" about the French documents and drawings sufficiently prove that certain changes were made therein at Paris by the inventor himself. The knowledge and experience of to-day shows us that Pinkus could hardly have practically carried out any of his systems of electric propulsion with motors of the Taylor type, but had he used some of the best types of pole changing and shunt wound electric motors then known—notably the French motors of Laurens of 1838, and Remond of 1839; together with the system devised by Boquillon of running several Clarke or Tranchard dynamo-electric generators in series or in parallel circuit, it is not unlikely that the Pinkus railway system could have been worked—if only on a small scale—as early as 1840. There is now no reason to question the operativeness of his mode of conducting the current from stationary generators to travelling car motors. In fact, some of the modern electric railway systems make use of sliding contact shoes. Then the arrangement proposed by Pinkus of connecting a supply conductor located in a hollow conduit with the end of a working conductor most remote from a generator of electricity at a central station, closely resembles the so-called feeder system of electric railways, in which a continuous supply conductor is normally or permanently connected at intervals with a working conductor. It does not appear that Pinkus contemplated attaching his supply conductor to more than one point of the working conductor, but in this connection it should be stated that in one of his earlier atmospheric railway systems, he maintained a uniform pressure in an air pipe from which the air is taken up to rotary motors on car axles, by connecting said air pipe at intervals with an air supply main. It will be seen that this is analogous to feeder systems of electrical distribution.

To show the bearing of the electrical inventions of Pinkus upon the modern art of the applications of electricity, it is only necessary to quote the claims of some American patents for electric railways and systems of propulsion. One of these claims of a patent granted about eight years ago, reads as follows, viz.:

"The combination of a machine or other source of electricity, conductors connected to the opposite poles of said source, and extending overhead along a road or course, a travelling electrical contact mounted on and capable of travelling along said conductors, having its opposite contacts insulated from each other, a vehicle, an electro-motor mounted on said vehicle, and having power connections with the axle thereof, and branch connections extending from the traveller to the poles of the motor.

The description already given of the Pinkus patents, Nos. 8,644 and 8,958, shows that the electrical conductors were also intended to be placed upon a so-called "suspension rail," which is a substantial anticipation of the patent claim above quoted.

Another claim of an American patent some nine years old for establishing an electrical communication between a travelling railway carriage and a main telegraph wire reads as follows, viz.:—"The combination of a travelling carriage, an overhead electrical conductor, a travelling contact mounted on and capable of travelling along such conductor and a branch conductor extending from said travelling contact to the carriage." It is needless to add that such a claim cannot be upheld in view of the patents of Pinkus relating to the applications of electricity for propulsion purposes.

Another American patent looked upon by some as having a fundamental or controlling claim, covering all modern electric railway systems with line conductors, will be recognised by quoting the claim, viz.:—"The combination of a stationary dynamo-electric generator driven by a suitable motor, a circuit of conductors composed in part of an insulated or detached section of the line of rails of a railroad track, a wheeled vehicle movable upon or along said insulated section of track, an electro-magnetic motor mounted upon said vehicle for propelling the same and included in said circuit of conductors and a circuit controlling device placed upon said vehicle."

As Pinkus did not contemplate using the railway rails as electrical conductors, the combination expressed in the foregoing claim is not met by his patents granted in the years 1840 and 1841.

After this period Pinkus ceases to be an inventor of electrical subjects, he is satisfied with having displayed in his patents Nos. 8,644 and 8,958, what Jules Verne has termed "l'audacieuse ingéniosite de la race Anglo-Saxonne." It certainly was audacious ingenuity to propose in the year 1840 systems of utilising electricity which only required the advent of the modern dynamo to make them industrially practicable. It will be seen that Pinkus in his description even goes so far as to give dimensions and distances whenever he speaks of electrical conductors and circuits, and a noticeable detail is that he proposed variously coloured insulated conductors and metallic conductors made of a bunch of uncovered wires. Then his proposition to lead conduits through fields and streets is also a very striking feature in view of what is being done to-day.

In the year 1848 we find that Pinkus filed an application before the Judicial Committee of the Privy Council for the extension of his English patents granted in the year 1834 for pneumatic railways. This application, however, was dismissed.

Probably discouraged by this check, Pinkus does not appear again on the scene as a patentee until the year 1865. He is then residing at Boulogne, France, and obtains patents in various countries for systems of conveying, storing and consuming petroleum and other liquids. True to his inventive nature the "coal oil fever" in his native State Pennsylvania, rouses him from his 20 years' sleep as an inventor and patentee. An English patent for the subject just mentioned is dated August 14th, 1865, No. 2,096.

Soon thereafter, Bessemer, Siemens, and others revolutionised the metallurgical art by their processes, and naturally a versatile inventor like Pinkus was not idle in the same direction, and we find him procuring patents in different countries for furnaces and metallurgical processes. The English patents on this subject are No. 2,792, of 1867, and 2,440, of 1869. In Italy he appears on the patent records as Enrico Pinkus, of Paris, France, this address being given in his Italian patents dated December 2nd, 1868, and Nov-

* The term dynamo-electric machine is here used in its broadest sense, *vide* definitions of Thompson, "Dynamo-Electric Machine," and Houston, "Dictionary of Electrical Terms."

vember 25th, 1869. We thus perceive that Pinkus was not only an "all round" inventor, but also an extensive traveller, in fact, a cosmopolitan in every sense of the word. A very noticeable fact is, that although Pinkus appears on the patent records of various European countries, he does not appear to have taken out any patents in the United States of America. He does state, however, in his English patent of 1869 that he has American patents for the same subject, viz., metallurgical furnaces and processes; the same having been obtained in the years 1867 and 1868.

Is it possible that he applied for patents only in the United States, and that the applications are still pending? Instances are known where American patents are issued many years after the filing of the application. The last English patent granted to Pinkus bears the date of December 12th, 1871, No. 3,359. It is for various systems of railways, asphalt pavements, furnaces, and a system of incandescent gas lighting. In this patent he refers to his earlier patents of the year 1840, and he gives his address in this patent as No. 62, Camden Road, London. The very last appearance of Pinkus as a patentee is in France. He here procures a patent No. 95,686, dated June 22nd, 1872, for metallurgical furnaces and processes and again he gives his residence as London—No. 62, Camden Road. Incidentally it may be mentioned that this at present is the locality occupied by the Metropolitan Provident Medical Association.

The writer has now reached the conclusion of his review of the inventions of Henry Pinkus, of Pennsylvania, as he himself styles himself in a publication found in the library of the British Patent Office, entitled "The Pneumatic Atmospheric and Gaso-Pneumatic Railway, London, 1840." For 45 years the patent records of Europe show that Pinkus was at work inventing and procuring patents. The important bearing of some of these upon the modern art of the industrial applications of electricity have been sufficiently set forth, and the future will show whether Henry Pinkus does not deserve the title of the pioneer "electrical inventor" of the nineteenth century.

The writer has not been able to learn much concerning the personality or the life of Henry Pinkus. His patents and publications, however, show that he was an engineer engaged in the construction of the Dublin and Dalkley Railway in Ireland, the Grand Junction Canal in England, and apparently he was also connected in some way with Fell's system of mountain railways. As to the date of his death, it is supposed to have occurred about the time of the Paris Exposition of 1878, this being the opinion of the patent agent at Paris who represented him in obtaining the French patent of 1872. This informant also, when asked something about Pinkus, said he was remembered at his office as an "American engineer." I leave it to another pen to write the biography or personal history of Henry Pinkus.

The object of the present article is more to present to the general electrical and scientific public the work of a meritorious inventor who deserves more than a passing mention in standard works on the history of the applications of electricity. The writer would here observe that the existence of the English patent No. 8,644 of 1840 has been known to a limited few for some years, but its bearing upon anything else than electric railways has never been recognised. Moreover, the patent in question being of such a voluminous nature, and the electrical features being intermixed with other non-pertinent subjects, it is doubtful if it has ever been carefully studied. Hence the presentation in a concise and regular form of the description of the English patent and drawings of the heretofore unknown French patent is thought to be of interest in this age of priority contests and patent litigation. At the very time when the writing of this article is about to be concluded, an American patent appears upon the scene which, although only granted on the 15th of December, 1891, is based upon an application filed September 15th, 1879. One of the claims of this patent is here quoted, viz.:—

"The combination of a railway track, one or more stationary means of electric supply, electrical conductors extending from said means of electric supply along the lines of said track, and consisting wholly or in part of the rails thereof, vehicles moving along said track, electro-dynamic motors whose coils are constantly excited so long as the poles of said motors are in circuits with the means of electric supply fixed upon said vehicles for imparting motion thereto, and wheels supporting said vehicles upon the track, and also serving to maintain continuous electrical connections between said means of electric supply and motors."

It will be seen that by this claim it is attempted to cover all modern electric railways in which the track rails and car wheels form part of the electric circuit.

The question now arises, how could such a claim be considered novel in view of the electric railways of Pinkus, and the now generally known electric railway of Bessolo, who had an insulated overhead conductor, and the track rails and car wheels as the circuit; and the electric railway of Cazal, in which the track rails alone and the car wheels formed the circuit from a stationary generator for a rotary electric motor on the car.

With this slight digression, showing the peculiar features of the American patent system, the writer closes his review of the patents of Henry Pinkus, and at the same time, he presents the name of this pioneer inventor of electric railways and the industrial applications of electricity, as being worthy of being joined with Henry, Morse, Page, Davenport, and others, on the memorial tablet of the electricity building at the coming Chicago Exposition.

MEASUREMENT OF THE POWER DEVELOPED BY ALTERNATING CURRENTS IN ANY CIRCUIT.*

By CARL HERING.

(*Continued from page* 62.)

HAVING now illustrated why it is that in measuring alternating current powers we cannot multiply the current by the voltage, without considering other things also, the following abstract of the above-mentioned articles may, perhaps, be better appreciated by those to whom these subjects were not clear. The various methods given below were suggested by Messrs. Ayrton, Sumpner, Swinburne and Fleming. The proofs of the formulæ, together with further information, may be found in the original articles.

Let it be required to measure the amount of power developed in any circuit, *a b*, fig. 4, no matter whether it be

FIG. 4.

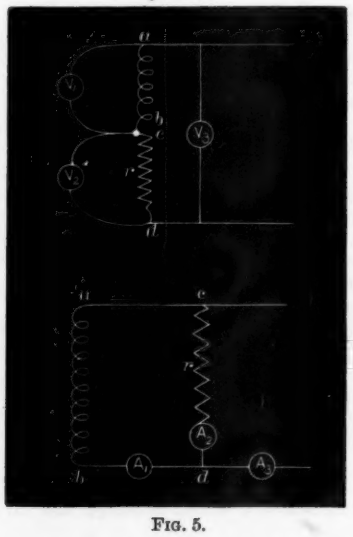


FIG. 5.

inductive or not, place in series with it a resistance, *c d*, whose resistance is *r* ohms. This resistance, *r*, must however, be a simple resistance, and must not be inductive, that is, it must be a non-inductive resistance, such, for instance, as a liquid resistance or an arrangement of wires which will have no inductive effects, or in general any circuit in which no magnetism is developed. It must therefore contain no solenoids or magnets of any description, and for accurate work not even an ampèremeter. With three volt-

* New York *Electrical World.*

meters measure the voltage at the terminals of each of these two portions of the circuit, and also at the terminals of the two wires in series, as shown in the figure ; the latter voltage is not necessarily equal to the sum of the other two, as it would be for continuous currents. Let these three voltages be represented by v_1, v_2, and v_3, as shown in the fig. The power which is consumed in the circuit, *a b*, may then be calculated directly in watts from these three voltages and from the resistance, *r* (in ohms), as follows : square the three voltages, and those of v_1^2 and v_2^2, and subtract their sum from v_3^2 ; this, divided by twice the resistance of *r* in ohms, will give the true power consumed in the circuit, *a b*, in watts. This may be expressed by the following formula, in which w is the power in watts :—

$$w = \frac{v_3^2 - v_1^2 - v_2^2}{2r}$$

As an illustration, suppose $v_1 = 50$, $v_2 = 52$, $v_3 = 100$ volts and $r = 5$ ohms ; the power will then be 10,000—(2,500 + 2,704) = 4,796 ÷ 2 × 5 = 479·6 watts. If the voltmeter has a resistance appreciably small compared with five ohms, then, instead of five ohms, use the joint resistance of the two, which will be slightly less than five ; also subtract the watts consumed by the voltmeter from the final result.

The best conditions for the test are obtained when the voltage at the terminals of the resistance of *r* is about the same as that at the terminals of *a b*.

The authors state that, with an error of one per cent. in each of the measurements of the three voltages, there would be a probable error of from four to five per cent. in the measurement of the power.

Instead of using three voltmeters, one may be used and connected to the respective parts of the circuit in rapid succession. The voltmeters had better be electrostatic (that is, electrometers), as they ought not to take an appreciable current, otherwise there will be errors introduced. A Cardew voltmeter, for instance, is said to take from 20 to 30 watts at high readings, and would, therefore, introduce large errors in measuring small powers. If the voltmeters are not electrostatic, that is, if they take an appreciable current, it will be more accurate to take the combined resistance of *r* and the voltmeter in multiple arc, instead of the resistance of *r* alone ; also, to subtract the amount of power consumed in the voltmeter, v, from that which is obtained by the calculation for the circuit, *a b*.

If the resistance, *r*, can be made just half an ohm the calculation will be simplified, as the power in watts will then be found by squaring the three voltages and subtracting the sum of the two smaller ones, namely, v_1^2, and v_2^2, from the larger one, v_3^2 ; that is, $w = v_3^2 - (v_1^2 + v_2^2)$, in which w is the true power in watts.

This method is entirely independent of any sine curve hypothesis, and is true whether the circuit, *a b*, in which the power is to be measured, is inductive or not.

Voltmeters are usually graduated to measure the square root of a mean square of an alternating voltage, although they really measure the mean square, and not the square root of the mean square. In this method, it would be better that they should be graduated in mean squares, and not in the square roots of the mean squares, thereby avoiding the necessity of squaring the readings. In that case the probable percentage of error in the measurement of the power is stated to be from 2 to 2½ times the error in the measurement of each of the voltages.

Approximate Calculation.

The following approximate calculation is given by the authors, Messrs. Ayrton and Sumpner. If, as is usually the case, the scale is graduated in square roots, the trouble of taking the squares may be saved when v_1 does not differ much from v_2 by proceeding as follows :

Calculate an auxiliary quantity, *a*, as follows :

$$a = 200\,\frac{v_1 - v_2 - v_3}{v_1}$$

then *a* will represent approximately the amount in per cent. that the true power is less than the apparent power. The apparent power (that is the power that would be absorbed if there were no lag between the voltage and the current) is equal to

$$\frac{v_1\,v_2}{r}$$

or if A is the current (that is the square root of the mean square of the current) this power will be equal to v_1 A, the same as for a continuous current. Diminishing this by *a* per cent. will then give the true power approximately ; the conditions being that v_1 and v_2 do not differ greatly from each other, and that their sum does not differ much from v_3.

To illustrate this, let $v_1 = 50$, $v_2 = 52$, and $v_3 = 100$, then from the above formula *a* will be equal to 8 per cent. The apparent power will be, for $r = 5$,

$$\frac{v_1\,v}{r} = 520 \text{ watts :}$$

diminishing this by 8 per cent. gives about 478·5 watts (the correct value is 479·6 watts).

Modifications.

If the resistance, *b c*, is not known, or if there is any fear that it may be changed by the passage of the current, then an ampèremeter (an alternating current ampèremeter, of course) can be inserted in the main circuit. Let A be the reading of this ampèremeter, which represents the square root of the mean square of the current, then as A is equal to $\frac{v_2}{r}$, we can substitute for *r* its value, $r = \frac{v_2}{A}$, and the formula will then be

$$w = \frac{A}{2\,v_2}\,(v_3^2 - v_1^2 - v_2^2).$$

In this case the non-inductive resistance, *r*, may be made up of incandescent lamps, for instance, since there is no objection to the resistance varying with different strengths of the current.

In order to avoid the objection to introducing an ampèremeter into the circuit on account of its inductive effect, the present writer suggests to place the ampèremeter in the main circuit outside of the points between which the voltages are measured. In that case the voltmeters must, however, take only inappreciably small currents.

Application to Measuring the Output of an Alternating Current Dynamo.

In order to avoid having to use, as is usual, a large non-inductive resistance to absorb the whole power of an alternating current dynamo, the same authors give the following application of their method :—

Use a non-inductive resistance for only a small portion of the external circuit and arrange it in the same way as shown in fig. 4 ; then the total power in the whole of the circuit (the inductive as well as the non-inductive part) will be, in watts :

$$w = \frac{v_3^2 - v_1^2 + v_2^2}{2r}$$

or in other words, square the voltages, add v_2^2 and v_3^2, and subtract v_1^2, then divide by 2 *r*, the *r* being, as before, the non-inductive resistance in ohms. To illustrate this by an example, we use the same numbers as in the example above, then

$$w = \frac{10{,}000 - 2{,}500 + 2{,}704}{10} = 1{,}020{\cdot}4 \text{ watts.}$$

It will be seen that this is the sum of 479·6 watts, which was found to be the power in the inductive circuit, and 540·8 watts (equal to the $c^2 r$ for the non-inductive resistance).

They anticipate that even if only a small portion of the external circuit is non-inductive, this method will give more accurate results than is often obtained by assuming that a so-called non-inductive circuit is really non-inductive, and therefore that the apparent power is the true power.

Fleming's Modification.

This voltmeter method has the objection that if, as is often the case, it is desired to measure the power which is being absorbed in a portion of the external circuit of a system, the dynamo would have to be forced to generate a much higher voltage than the normal, on account of the introduction of the resistance, *r*, assuming that the measurement is to be made without interfering with the voltage in

the rest of the external circuit. This would often be awkward, and in many cases, in fact, out of the question. In order to overcome this objection Dr. Fleming has suggested the following modification of this method which will be applicable in such cases, and will enable transformer tests to be made on working primary circuits without interfering with the voltage of the alternator.

Instead of placing the non-inductive resistance, r, in series with the external circuit, $a\ b$, place it in multiple arc with the same; and instead of using voltmeters use ampèremeters A_1, A_2, A_3, as shown in fig. 5. Messrs. Ayrton and Sumpner have pointed out that for every problem involving alternate *voltages* in *series*, there was an analogous problem involving alternate *currents* in *parallel*. It will be seen by comparing figs. 5 and 4 that the former is quite analogous to the latter. In this case the formula will be

$$W = \tfrac{1}{2}\, r\, (A_3^2 - A_1^2 - A_2^2),$$

which is seen to be quite analogous to the other, except that r is used as a multiplier instead of a divisor. This method is inferior to the other, in so far as it requires the use of three ampèremeters, which must be accurately calibrated; it is not possible in this case, as in the other, to switch the instruments successively into the three places; in using the voltmeter method, it is an easy matter to make the test with one instrument. Another objection to this current method is, that it does not possess the accuracy of the voltmeter method; for in order that the three-current method may give accurate results, it is necessary to assume the entire absence of any inductive resistance in the circuit. As the ampèremeters usually contain a coil, their resistance is not non-inductive, and they therefore introduce an error.

MODIFICATION.

In order to avoid the objections just stated, a modification is suggested and is shown in fig. 6. The arrangement is

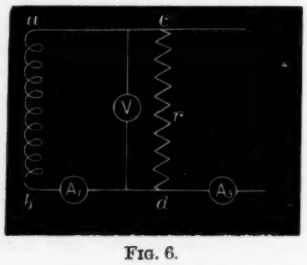


FIG. 6.

quite similar to the one just described, with the exception that instead of placing an ampèremeter in the non-inductive circuit, a voltmeter is placed at its terminals, as shown by V. In this case the current in the non-inductive resistance, r, is evidently $\frac{V}{r}$, and the formula then will be

$$W = \tfrac{1}{2}\, r \left(A_1^2 - A_1^2 - \left(\frac{V}{r}\right)^2\right)$$

If the voltmeter used in this test be a hot wire instrument, then, since an appreciable current will pass through it, r must be taken as the parallel resistance of $c\ d$ and the voltmeter together. It might be observed, however, that there is no necessity to know either of these resistances separately, since the value of r can be determined very readily by calibrating the instruments relatively as follows:

First break the circuit of $c\ d$, and also that of the voltmeter, and compare the deflection of the ampèremeter, A_3, with that of A_1. They ought to be alike, but if there is an error, note it. Second, close the circuit of $c\ d$, and of the voltmeter and break the circuit, $a\ b$. A_3 is now in series with the parallel circuit of $c\ d$ and the voltmeter, and will measure the current in the two together. The value of r is then readily calculated, since it is equal to the volts read at V, divided by the amperes read at A_3.

This latter method appears in general to be the best of all of the above, as there are the least objections to it, and the errors can all be corrected if the work is to be very accurate. The choice between these methods, however, will depend upon the particular conditions, and therefore it cannot be said that any one of the methods is best under all circumstances.

ELECTRO-MAGNET SHUNTS.

BY W. MOON.

FOR many years past some shocking coils have been provided with copper or brass tubes which are slid a greater or less distance over the iron core to vary the severity of the shock. These tubes perform this function by retarding the rate of magnetisation and demagnetisation of the core, thus reducing the induced E.M.F.

The idea suggests itself whether an electro-magnet shielded with a copper tube would not be slower to demagnetise than one provided with a fine wire shunt. And therefore whether such a shielded electro-magnet would not be better for such purposes as the automatic switches used in telegraphy than the present shunted electro-magnets.

Consider, for instance, an electro-magnet of resistance, R, shunted by a resistance, S, and excited by a battery of E.M.F., E, and resistance, r. Then if the shunt, S, be removed, the electro-magnet need only be wound to a fewer number of turns having a resistance, R_1. Suppose that in both cases the electro-magnet is wound with the same gauge wire, and so wound that

$$R : n :: R_1 : n_1$$

then the relation between R_1 and R so as to obtain the same magnetising force in each case will be

$$C\, n = C_1\, n_1 \quad \therefore C\, R = C_1\, R_1$$

$$\therefore \frac{E}{\left(r + \frac{R\,S}{R+S}\right)} \cdot \frac{R\,S}{(R+S)} = \frac{E\,R_1}{R_1 + r}$$

whence

$$R_1 = \frac{R\,S}{R+S}.$$

Now in the case of the electro-magnet without the shunt there is a length of wire, $R_2 = R - R_1$, which can be wound upon it as a secondary coil, and short circuited, and it is necessary to enquire what are the conditions that are required to make this secondary coil equally as effective as the shunt.

Now the time of discharge of the shunted electro-magnet is

$$t = 2\,\frac{L}{R+S} = \frac{2\,l\,n}{C\,(R+S)}$$

and for the electro-magnet with the secondary coil is*

$$t = \frac{2\,m^2}{L_1\,R_2} = \frac{2\,l_2^2\,n_2^2}{l_1\,n_1\,c_1\,R_2}$$

$$\therefore \frac{2\,l\,n}{c\,(R+S)} = \frac{2\,l_2^2\,n_2^2}{l_1\,n_1\,c_1\,R_2}$$

Now since the electro-magnets are equally excited

$$l = l_1 = l_2 \text{ and } n\,c = n_1\,c_1$$

$$\therefore \frac{2\,l\,n^2}{n\,c\,(R+S)} = \frac{2\,l^2\,n_2^2}{l\,n\,c\,R_2}$$

$$\therefore \frac{n^2}{R+S} = \frac{n_2^2}{R_2}.$$

But since each electro-magnet is wound with the same gauge of wire equally distributed throughout the space of the reels

$$n : R :: n_1 : R_1 :: n_2 : R_2$$

$$\therefore R_1 = \frac{R\,S}{R+S}$$

But this is the condition that the electro-magnet shall in each case be equally excited. And, therefore, whether the shunt or the secondary coil is used, the electro-magnet would be equally excited and would lose its magnetism in the same time, provided

$$R_1 = \frac{R\,S}{R+S}.$$

It remains to be seen whether the two electro-magnets would acquire their magnetism at the same rate.

The time of acquiring its magnetism with the shunted electro-magnet is

$$t = \frac{2\,L}{R + \frac{r\,s}{r+s}} = \frac{2\,l\,n^2}{n\,c\left(R + \frac{r\,s}{r+s}\right)}$$

* ELECTRICAL REVIEW, December 12th, 1890.

and that of an electro-magnet with a secondary coil is

$$t = \frac{2}{L_1}\left(\frac{L_1^2}{R_1 r} + \frac{M^2}{R^2}\right) = \frac{2\,l}{n_1 c_1}\left(\frac{n_1^2}{R + r} + \frac{n_2^2}{R_2}\right)$$

Equating these two values of t to find the conditions necessary to make the time of charge equal in both cases, we get, since

$$n_1 c_1 = n c$$

$$\therefore \frac{n^2}{R + \frac{r s}{r + s}} = \frac{n_1^2}{R + r} + \frac{n_2^2}{R_2}$$

But $$R_2 = R - R_1$$

and $$n : R :: n_1 : R_1 :: n_2 : R_2$$

$$\therefore \frac{R^2}{R + \frac{r s}{r + s}} = \frac{R_1^2}{R_1 + r} + R - R_1$$

$$\frac{R^2}{R + \frac{r s}{r + s}} = R - \frac{R_1 r}{R_1 + r}$$

Whence $$R_1 = \frac{R S}{R + S}$$ as before.

As an example, take the automatic switch used on the P.O. repeaters. This instrument is wound to 60 ohms and shunted with a coil of 60 ohms, wound upon a small reel and placed under the base of the instrument. If the shunt of this instrument were removed and the coils of the electro-magnet double wound, and one of the two coils short circuited to make a secondary circuit, and the other placed in the battery circuit, then this instrument would act in exactly the same way with the secondary circuit as it does with the shunt.

Instead of the electro-magnet being double wound, it might have the one coil outside the other. But in this case both the depth of the two coils and the gauges of the wire would have to be different so as to maintain the number of turns and the resistances of the two coils the same.

Let d_1 and d_2 be the internal and external diameters of the coil, and d_3 the intermediate diameter that separates the two coils, then when it is required to replace a shunt of equal resistance to the electro-magnet by a secondary coil

$$\frac{d_2 + d_3}{d_2 - d_3} = \frac{d_3 + d_1}{d_3 - d_1}$$

$$\therefore d_3 = \sqrt{d_1 d_2}$$

and the altered gauges of the wires of the two coils will be found from the relation

$$\sqrt{\frac{d_2 - d_1}{2}} : \delta_0 :: \sqrt{d_2 - d_3} : \delta_2 :: \sqrt{d_3 - d_1} : \delta_1$$

where δ_0 is the gauge to which the coil was originally wound, and δ_2 and δ_1 the gauges of the external and internal coils respectively.

Practically it is immaterial whether the primary coil is inside or outside the secondary coil. Let it for instance occupy the space, $d_2 - d_3$, and be wound to a gauge of wire,

$$\delta_2 = \sqrt{\frac{2\,(d_2 - d_3)}{d_2 - d_1}}$$

Then the secondary coil will occupy the space, $d_3 - d_1$.

Now the time of discharge of the secondary coil is

$$t = \frac{2\,l_2^2 n_2^2}{l_1 n_1 c_1 R_2}$$

but since $$\frac{2\,l_2^2}{l_1 n_1 c_1}$$

is independent of the gauge of the wire of the secondary coil, and $n_2^2 \propto R_2$, it is immaterial to what gauge of wire the secondary coil is wound, if the insulation varies as the diameter of the wire. And further if the whole space, $d_3 - d_1$, were occupied by one turn of wire, that is to say if a solid copper tube occupies that space, then the thickness of the insulation of the secondary coil, and the spaces between the turns of wire would be saved, and such a solid tube would act about twice as effectively as a coil of thin insulated wire. And therefore an electro-magnet shielded by a copper tube of an appropriate thickness would demagnetise more slowly than one provided with a shunt.

"ELECTRIC" TANNING.

THERE is perhaps no art that is more conservative than the art of tanning; some of the practices of the modern tannery are absolutely identical with those in use hundreds of years ago. But the industry of tanning is yielding up many of the prejudices that have hampered its progress, and its votaries are paying more and more attention to the suggestions of science.

Some months ago we gave an account of the use of electricity as an adjunct to the manufacture of leather, and we are likely to hear more of it at the forthcoming exhibition of the leather trades at the Agricultural Hall, Islington. We understand that the rival processes of "tanning by electricity" will be on show at this exhibition, and may be studied there.

The British Tanning Company, who were the first to try to use electricity in the tannery on a commercial scale are industriously pushing on with their process; but, according to our contemporary, *Leather*, Mr. Groth's method of utilising electricity appears most likely to triumph in the end.

English tanners have been more than usually incredulous as to the uses of electricity in tanning, but it would appear that their foreign *confrères* retain a more open mind on the subject, for the Groth system is being tried in most of the chief leather producing countries, and, as we are informed, with eminent success.

English tanners may, with advantage, be reminded that they have something yet to learn from leather manufacturers on the continent, to say nothing of their American competitors. There is no doubt that far too large a quantity of leather is brought into this country from abroad, and that many classes of leather which are brought here might be produced equally well at home. The unpleasant fact is, that even in these *fin de siècle* days Englishmen are a little too apt to look down upon "foreigners," and English tanners to be sceptical as to the value of new methods brought before their notice.

The application of electricity to tanning is stated to be advantageous, and it would be a pity to lose any opportunity of improving leather manufacture. No one, we presume, would assert that electricity is destined to revolutionise the tanning trade, but there is undoubtedly "something in it." What is wanted is such development of these electrical systems as will make them, above all things, economical. As soon as the inventors of "electric" tanning can show that it pays, then we have no doubt that they will rapidly succeed in getting their systems adopted. The sooner, the better, from our point of view.

ELECTRICAL NOTES FROM DEMERARA.

[FROM OUR OWN CORRESPONDENT.]

GEORGETOWN, Demerara, might with some show of reason change its name to that of Pole-land, for the streets have recently been filled with the poles of the British Guiana Electric Lighting and Power Company, Limited, in addition to the telegraph and telephone lines, and the West India and Panama Company's poles. Unfortunately, a very reckless disregard of the Government telegraph and telephone lines has manifested itself during the erection of the recent cables and wires by the Electric Lighting Company, so that it was not only a daily, but at one time, an hourly occurrence to have telephone wires put in contact by the dragging of the cables over the telephone lines, without the slightest regard for consequences. Prior to those Yankee operations, Mr. Vyle, the Government electrician, had by special permission been one of the directors, but one Saturday after his return from a lengthy visit to the gate of the Gold Fields, finding that all his appeals to the chairman and engineer to remove their heavy wire off an important telephone line were no use, he after twenty-six hours' notice chopped their cable in two, when twenty minutes after, the work required to be done before, was accomplished. But the spell had been broken, and the good feeling before existing, was destroyed, and Mr. Vyle at once tendered his resignation, the position of consulting electrician which he first held having lapsed on his becoming a director.

To show the effect of such work, the cable communication

to Trinidad and Europe was cut off three several days in succession by the Electric Lighting Company's workmen dragging their lines over one of the telephone wires and stretching it—actually breaking in one instance—so that it fell in contact with the West India and Panama Company's wires that passed below. For hours the Georgetown telephone exchange was connected with the cable company's office at Trinidad, and the officers at Georgetown were left to wonder what was up.

The Town Council having entered into a contract with the Electric Lighting Company to light by electricity a certain area of the City, an extra steam engine and boiler power for 130 H.P. have been provided and laid down, and 200 25-C.P. lamps are run in series of 40 off very heavy cables, capable of carrying 70 amperes at 1,000 volts, which will feed the transformers, also for house lighting. Some 18 arcs of nominal 1,200 C.P. are also provided in readiness for the new year. For the institutions of the town the company wanted 20 cents per unit for the electricity supplied, but the persistence of the Municipal authorities compelled the lighting company to accept 15 cents. Already some 600 private lamps are being lit, and orders for others have been kept back on account of providing in good time for the work now completed. Trial runs have been made of the city lighting, although no tests of the electric cables and wires have been made. To an English mind, wooden pins carrying glass insulators look antiquated and anything but substantial or good insulation, and crossing of streets almost at right angles without a stay of any kind, is of the type of what is best described as being "slung." The large cables of solid wire over ¼ inch diameter are freely joined—jointed should I say?—with the short bellhanger's twist, and look as if the strain would separate them, so that, carrying as they will by-and-bye over 100 H.P. of electrical energy, it looks prospectively possible for a serious disaster to occur. Provision is made for an electric inspector, but he is not yet appointed. The testing apparatus of the electric company consists of a magneto bell; there is only one Wheatstone bridge in the Colony, and only one person having experience as to its use.

Recently the staff of the telegraph department was strengthened by the arrival in the Colony of Mr. Gilbert C. Vyle as Assistant Electrician, and Mr. Jno. Marshall as Foreman of linemen, both selected by the Secretary for the Colonies.

ILLUMINATION OF GALATZ WITH GAS AND ELECTRICITY.

[FROM OUR OWN CORRESPONDENT.]

THE Municipality of Galatz, in Roumania, has taken the somewhat peculiar resolution of granting a concession for lighting the city with gas and of simultaneously granting to the grantee the exclusive right of electric lighting within the streets for 12 kilometres run. The schedule of conditions and arrangements is as follows:—

(It is to be noted that throughout the schedule gas is always spoken of as "fluid gas." If this epithet is not perfectly needless it would mean gas liquefied by compression, which is practically out of the question.)

CHAPTER I.—GENERAL ARRANGEMENTS.

Section 2.—This concession will extend for 40 years from the date of the signature of the concession.

Section 3.—The community grants to the concessionary a plot of two hectares in the lower town near the railway terminus.

Section 9.—All the works for public lighting must be completed and put in working order within at latest two years from the date of the signature of the concession.

Section 10.—The concessionary is, however, at liberty to commence public lighting with gas, entirely or in part before the term fixed in Section 9 on giving three months' notice for each 5,000 metres of mains which he purposes setting in action.

CHAPTER II.

Section 15.—If the operations necessary for laying down the gas pipes necessitate the removal or alteration of objects or buildings of any kind on private ground, the concessionary is to come to a friendly arrangement with the respective proprietors (!).

Section 16.—Except in the case provided for under Section 15, the concessionary is responsible for all damage or accidents occasioned by his operations whether on public roads or on private property.

CHAPTER III.

Section 24.—The concessionary agrees to keep in stock a supply of coal sufficient for two months' consumption, from April 1st to October 1st, and for four months' consumption for the rest of the year.

Section 26.—The illuminating power of the lamps for public service will be 1½ carcels.

Section 35.—Ten years after the signature of the contract the concessionary will be bound to reduce by 10 per cent. the price of the gas supplied for the public service, and the same reduction will take place at the end of every further period of ten years. The same reduction will be allowed to private consumers. No similar reduction will be made for electric lighting.

CHAPTER IV.—PRIVATE LIGHTING.

Section 39.—Private consumers can demand only for the time of public lighting. A supply for longer hours can be obtained only by special agreement.

CHAPTER V.—ELECTRIC LIGHTING.

Section 40.—The concessionary has the right to light up the streets, &c., with electricity for an extent not exceeding 12 kilometres, measured from the central station.

Section 42.—The community has the right of demanding the installation of the electric light at the commencement and simultaneously with the lighting with gas.

Section 44.—The leads for electricity will be placed underground, except in cases when it would be impracticable.

Section 47.—All improvements which may be invented in the mean time, must be introduced by the concessionary.

CHAPTER VI.—PRICES.

In this chapter no figures are given either for gas or electric current.

CHAPTER VII.

Fixes penalties for deficient supply of gas, for broken lamps and for irregularities in the service.

CHAPTER VIII.—GENERAL ARRANGEMENTS.

The concessionary submits himself entirely to the Roumanian laws and must take up his abode at Galatz or leave in his stead a plenipotentiary. He must deposit a guarantee of 50,000 francs. If the works are not completed at the term specified the guarantee is forfeited except the delay arises from causes independent of the will of the concessionary. During the entire term of the concession he can introduce his raw materials and whatever is necessary for the installation and working of the concession free from the octroi tax.

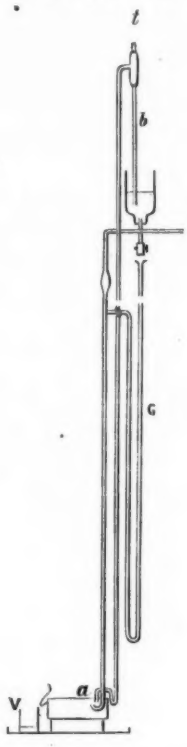
Every person tendering must specify his charges for each burner supplied with gas at the rate of 2,500 hours yearly, for gas burnt per cubic metre, for electric current per hectowatt for arc lamps, and per carcel hour for glow lamps. Separate prices must be given per cubic metre of gas and for electric current per carcel hour. Each person tendering must deposit as guarantee 25,000 francs.

The Electric Lighting of Pontypool.—In connection with this matter a largely attended meeting of leading tradesmen and local capitalists was held on Wednesday afternoon, last week, when the advisability of adopting electric lighting in the town instead of gas, as hitherto, was fully gone into; Mr. Edwin Fowler presided. After hearing a statement from Mr. J. C. Howell, the well-known electrical engineer of Llanelly, as to the cost of the electric system, the meeting unanimously decided in favour of the scheme, and a committee was formed for the purpose of canvassing the town with a view of ascertaining the probable number of lights repuired.

AN IMPROVEMENT IN THE SPRENGEL MERCURY PUMP.

THE proper manipulation of vacuous vessels, and the convenient production of vacua, are matters of great interest to the manufacturers of incandescent electric lamps, and any improvement will be welcomed by them. The Sprengel pump we presume is an apparatus with which all are familiar; but it has recently received an important development by means of which the mercury is automatically replaced.

The mercury is continuously and automatically transferred from the lower to the upper reservoir by the action of a "water pressure" or similar pump, the suction tube of which is attached to the upper end *t* (*vide* figure) of a



small bulb, connected by tubes *a* and *b* to both reservoirs, and placed about 40 cm. above the upper one. The contents of the lower reservoir are thus forced into the bulb by atmospheric pressure, and allowed to fall into the upper reservoir by their own weight. The tube *a* is 3 mm. in internal diameter, and is received at the lower end, the level of the mercury at that point being so adjusted that much air and little mercury passes up the tube; the tube *b* is 6 mm. in internal diameter.

This apparatus is due to Mons. A. Verneuil, and is applicable to most existing mercury pumps. It is not intended to be used at starting, as it is found more convenient to transfer any considerable quantity of mercury by hand than to make the apparatus of unnecessarily large dimensions.

An incidental advantage is that the mercury is brought into contact with air under conditions favourable to the oxidation of impurities.

A STUDY IN ELECTROLYSIS.

A SHORT time ago we noticed an investigation by Dr. T. S. Murray on the electrolysis of potassium acetate solutions. This substance is in no way of much importance in itself, but it has been made use of in performing a research, the results of which are very instructive. This research has been carried on in the laboratory of the University of Edinburgh, and as some further details have come to hand, we shall now give it a longer notice.

Dr. Murray, in his paper which was communicated to the Chemical Society, prefaces his results with some general observations on the subject of electrolysis, from which we make the following abstract:—When an aqueous solution of an acid or of a salt is electrolysed, there occurs a migration of the electro-positive hydrogen or metal, as the case may be, towards the negative electrode, and of the electro-negative residue, the acid radicle, in the opposite direction towards the positive electrode. At the respective electrodes, these so-called ions give up their electric charges, and become chemically free.

Whatever view may be taken as to the mechanism by which the electrically charged ions find themselves at the electrodes, it remains that the part of the electrolysis of chemical import is the discharge of the ions on their reaching the electrode of opposite charge. The ions, freed from their charges, are in general incapable of existence as such; hence, subsequent chemical changes take place, resulting in the formation of more stable compounds.

Perhaps the simplest type of electrolytic decomposition is when the discharged ions combine with themselves to form molecules, as in the instance of the electrolysis of aqueous hydrochloric acid; here the single hydrogen atoms unite to form molecules, and similarly with the chlorine atoms. Very often, however, the accompanying chemical reactions are such as give rise to products differing entirely from the original ions. Besides, being able to unite with one another, the ions may suffer decomposition into simpler compounds, or they may react on water, or on the electrolyte; or they may be oxidised or reduced, and so forth.

Examples of these differences of behaviour are to be found among many inorganic acids and salts; but it is in the electrolysis of organic acids, owing to the presence of large and, it may be, easily oxidisable groups, that the most complicated secondary reactions occur. The electrolysis of potassium acetate well exemplifies this. When a very dilute aqueous solution of potassium acetate is electrolysed, the electro-positive potassium ions, on being discharged at the cathode, react with the water to form caustic potash, and an equivalent of hydrogen, which is evolved; and, similarly, the electro-negative, $CH_3 . COO$ ions, or acetions, discharged at the anode, react with water with formation of acetic acid and liberation of oxygen.

If we neglect the separation of potassium acetate into caustic potash and acetic acid, the products of the electrolysis are those of a decomposition of water. The reactions are expressed by equations thus:—

$$K + HOH = KOH + H$$
$$2\,CH_3 . COO + HOH = 2\,CH_3 . COOH + O$$

Most acids and salts in dilute solution suffer a similar decomposition when electrolysed. Such an electrolysis, when the products are those of the decomposition of water, may be called a *Faraday electrolysis*.

If the solution of the acetate be concentrated, the reaction becomes more complicated. It was Kolbe who first sought to investigate the electrolysis of concentrated solutions of potassium acetate and of other similar organic salts. [*Annalen*, lxiv., p. 339; lxix., p. 257; *Quart. Journ. Chem. Soc.*, ii., p. 157.] He found that, with a strong solution of potassium acetate, the chief reaction is as follows:—

Hydrogen is liberated at the cathode as before, but now the acetions act on one another so as to form ethane and carbonic anhydride, thus:

$$CH_3 . COO + CH_3 . COO = C_2 H_6 + 2\,CO_2$$

This may be called *Kolbe's first reaction*. Simultaneously another reaction proceeds, but to a very limited extent. A small quantity of methyl acetate is formed according to the equation

$$CH_3 . COO + CH_3 . COO = CH_3 . COO . CH_3 + CO_2$$

This type of reaction may be called *Kolbe's second reaction*. The gas obtained on electrolysing a concentrated solution of potassium acetate possesses a peculiar ethereal odour, which Kolbe showed to be due to the presence of a vapour having properties identical with those of methyl acetate. Although the substance is present in such small quantities that it has never been isolated with certainty, yet with other acids belonging to the acetic acid series, a large proportion of the decomposition takes place according to this type of reaction;

for instance, potassium valerate, on electrolysis, yields a large quantity of butyl valerate (Kolbe, *loc. cit.*).

Besides the three electrolytic reactions named—the Faraday, and Kolbe's first and second reactions—there occurs, in addition, oxidation of a portion of the electrolyte by the electrolytic oxygen.

The Faraday reaction occurs even with saturated solutions of the acetate, but the oxygen formed is never liberated as such, being entirely used up in oxidising the electrolyte, or rather, perhaps some product of the electrolysis.

The formation of ethane has been explained by certain chemists (Burgoin, Jahn, Bunge) in a different way from that given by Dr. Murray; they regard the ethane as the result of a partial oxidation of the acetic acid by the electrolytic oxygen, but Dr. Murray advances some strong arguments in favour of his own view being correct.

That Kolbe's reaction becomes more marked in strong solutions is due to the increased concentration of the acetions at the moment of their liberation. As the ions become more closely crowded together they react to a large extent on one another, and to a less extent on the water of solution. The concentration of the liberated ions is dependent primarily on the strength of the solution, and on the current density at the electrodes, the latter varying with the size of the electrodes and the strength of the current. The secondary reactions are also influenced by temperature, and the presence of alkali or acid in the solution likewise appears to have an effect.

At the suggestion of Professor Crum Brown, Dr. Murray, undertook an investigation with a view to tracing the connection between the composition of the electrolytic gas and the various factors which might be expected to influence the electrolysis.

An ingenious apparatus was used, which however we cannot afford space for description here, and Dr. Murray divided up his work into a consideration of the following:—(1) The presence of ethereal vapours in the electrolytic gas. (2) The influence of the concentration of the solution on the electrolysis. (3) The strength of the current. (4) The size of the electrodes. (5) The influence of temperature. (6) The influence of acid or alkali. (7) Oxidation. The account of these researches is profusely illustrated with curves which depict the results graphically, and make it clear that Dr. Murray has a quiver full of arguments wherewith to support his theoretical views.

This piece of work is a good example of a class of research which is being studied just now very earnestly, and which we anticipate will prove pregnant with results of the highest order. It is perhaps on the borderland of chemistry that scientific explorers will in the future make the most extraordinary discoveries relating to the constitution of matter and its physical behaviour, hence every step in this direction should be regarded as important and certainly worthy of consideration.

SYNOPSIS OF THE HISTORY OF OZONE—1840 TO 1892.

1840.—Schönbein, while electrolysing water, observes the peculiar smell of the substance which he calls *ozone*, and ascertains that it is identical with the *aura electrica* developed on the points of an electric machine.

His papers to the Munich Academy of Sciences on the subject. According to him, *there is in atmospheric air*, as well as in water, an *electrolyte*, of which *the electro-negative element or anion contains an odoriferous principle.*

He pretends that the *presence of nitrogen is indispensable* for the generation of ozone. Almost all the scientists criticise the facts and theories asserted by Schönbein.

1841.—De Moleyns reads at the British Association a paper on the nature and properties of the *new element*, or of the *product of the electric action* mentioned by Schönbein. He says that this odour can be produced by all metals, and even by carbon, and *exhibits his ozoniser, which consists of a magnet rotating in a glass cylinder.*

1842.—W. Gann, at the London Electrical Society, says that the *ozone odour is due* to the volatilisation of a small quantity of the *metallic matter of the positive electrode.*

1843.—Polemics between Schönbein and De la Rive. This latter says that *ozone is not to be found in atmospheric air*, or in water, and that *electric discharges cannot produce chemical decomposition.*

Schönbein writes to Faraday that ozone is a compound of oxygen and hydrogen.

1845.—De la Rive and Marignac ascertain that *under the influence of the electric spark, dry oxygen yields ozone*; therefore, ozone is nothing else but *oxygen brought to the peculiar state* in which a gas possesses properties which it has not in its natural state.

This discovery upsets the theory of Schönbein, who thought it was a compound of nitrogen. All sorts of disputes and controversies are raised in the scientific world about ozone.

Versatility of Schönbein, who now declares that De la Rive and Marignac are wrong, and that *ozone is peroxide of hydrogen*, but that it is not a peroxide similar to Thénard's peroxide of hydrogen. He mercilessly runs down at the London Chemical Society, Williamson, who had declared that hydrogen is one of the components of ozone.

1846.—Polemics with Fischer.

Experiments made by Schönbein to prove that *hypo-nitric acid and ozone are not identical.*

1847.—Berzelius says that ozone is not a separate element, and that it is neither a combination of known elements. His quotation of the statement made by Lench that O^n, representing galvanised air, is *the most powerful bleaching agent.*

Letter of Schönbein to Faraday, written, instead of ink, with a manganese sulphate solution, which has turned brown under the action of ozone.

Test discovered by Schönbein to ascertain the presence of ozone.

Formation of permanganic acid by means of ozone.

1848-49.—Baumert produces ozone by electrolysis.

1850.—Note by Becquerel at the Académie des Sciences, showing by its reticences how little ozone was known.

1851.—Lecture by Faraday at the Royal Institution on the *formation and properties of ozone.*

Dr. Hare's lecture at the Franklin Institute on the *resemblance of the odour of ozone and the odour emitted by flint struck by steel*; his theory.

[Becquerel and Fremy *are the first to obtain ozone by electrification of oxygen in tubes, without wires.*]

1852-3.—Baumert says that ozone is *allotropic oxygen* when produced by sparks, and *peroxide of hydrogen* when produced by electrolysis.

1854.—Le Blanc *bleaches by means of ozone*; he thinks that ozone and water form peroxide of hydrogen.

1855.—First paper of Andrews showing that there is *neither hydrogen nor nitrogen in ozone*, and that there *is only one ozone, which is allotropic oxygen.*

1855.—Information given by Houzeau on *nascent oxygen* or ozone, the *savour* of which he compares to that of *the lobster.*

1857.—Siemens *constructs his ozoniser*, which is afterwards modified by Wills.

1858.—Theory of Clausius on the formation of ozone, the atoms of which are *electrically in conditions contrary one to the other.*

1858.—Frémy and Becquerel had given to ozone the names of *Electrified oxygen*, and then of *Active oxygen*; Becquerel proposes the name of *odoriferous oxygen.*

1858.—Experiments made by Quet on the decomposition of gases by *continuous currents.*

Researches of Ozann and Jamin on ozone, platinum, and ozonised hydrogen.

1859.—Andrews and Tait show that oxygen *cannot be entirely ozonised*; they preferably use the electric machine rather than the coil; they say the quantity of ozone produced by electrolysis is infinitesimal.

1860.—Gorup-Besanez recommend ozone for *bleaching old engravings.*

1860, April.—Data supplied by Andrews on the yield of ozone by electrolysis; his machine and apparatus for producing ozone. *Who is the first electrician who suggested the use of silent discharges?*

1860-61.—Leroux: his formation of ozone by heating platinum.

Saint-Edme refutes him.

1861.—Sauvage tries to prove that what is commonly called ozone is *merely hyponitric acid.*

1862.—Thesis of Schmidt on the ozone contained in the blood.

Lichtenstein publishes a study on ozone and its therapeutical uses.

Schönbein writes to Faraday to tell him that he has succeeded in separating ozone from ozonides.

1863.—Soret and the results he obtained by electrolysis *at low temperatures*. He proves that Baumert was wrong when stating that *electrolytic ozone* is an oxide *of hydrogen*.

1864.—Saint-Edme declares that *oxygen separated by electrolysis from a binary compound is not ozonised*.

Opinion of Clerk Maxwell on the action of heat on ozone.

Berthelot's experiments on heat and ozone; the *transformation of oxygen into ozone absorbs* 29,600 *units of heat*.

1865.—Schönbein fancies that ozone contains nitrous acid; polemics with Sterry Hunt.

Frémy pretends that the ozonometric observations are almost useless; that *there is no ozone in the air*.

1866.—Schönbein destroys cyanine by ozone, and restores its colour by thallium; his *theory on the bleaching of cloth on the grass*. Ozone *bleaches only in presence of water*.

Dr. Daubeny shows that fluor spar evolves by friction the smell of ozone.

1867.—De Gerbeth *purifies oils and petroleum by ozone*.

Paris Exhibition; the report of the jury mentions *Wilde's machine, which is used for bleaching sugar in Whitechapel*.

1868.—Craft, in America, *improves alcohol by ozone*.

Gibbons: his experiments with a glass tube in a mixture of oxygen and ether; explosion which ensues.

Lhote and Saint-Edme show before the members of the Académie des Sciences of Paris *the Ladd condenser*. Ladd's condenser is nothing else but *Beanes' condenser*, which had been *constructed by Apps* and *modified by Ladd*.

De Luynes shows the same apparatus at the Société pour l'Encouragement de l'Industrie. *Beanes' apparatus is called this time: "Ozonogène Ruhmkorff."*

1869.—Beanes writes a letter to say that a *brown syrup has been bleached by him by passing through it a current of ozone during three hours*.

1870.—The American Dunderdale, invents an ozoniser made of *metallised glass plate*. He *applies ozone to the ageing and improving of spirits*.

Prosser *ozonises oils and bleaches them*.

Barrett: his ozonising baths for curing all sorts of diseases.

Bloxam says that *tinned glass under the action of an induction coil ozonises the air*.

(*To be continued.*) E. A.

FRAUDS IN THE ELECTRICAL BUSINESS.*

As a conclusion to this list of electrical fakes we will now consider the medical part of the business. Here we find among the so-called electrical appliances, such as belts, hair brushes, corsets, &c., gross imposition is practised under the name of electricity upon the public, and has been for years. There is hardly a complaint in the human calendar of diseases that these things, according to flaring advertisements and circulars will not cure. To show to what an extent this imposition is practised at the present day, I will read an extract or two from a full-page advertisement taken from one of the most highly respectable magazines in this country:—

"Disease is the result largely of depleted nerve force and demagnetised blood. These electro-magnetic corsets (the maker's name is here mentioned), belts, insoles, and appliances, have been demonstrated to be the best agency yet discovered for preventing this depletion and demagnetisation as well as restoring such forces when lost. These garments are unlike any other device for electrifying the system or charging it with magnetism. As a force it is self-supplying, retaining its virtue for years, and invariably benefits. These appliances so electrified can always be relied upon.

"These appliances promptly annihilate those weak and languid feelings, exterminate rheumatism from the system, and promptly cure the above-named disorders. They are light and comfortable to wear, and are guaranteed to imperceptibly generate a mild continuous current of electro-magnetism, all-healing in its effect. They differ from the so-called electric and galvanic belts, which are usually worthless, and which create sores on the body, leading to blood poisoning. Beware of them and see that you get this one (our special make) with silver compass free. Ours are truly electro-magnetic, as any tyro in electric therapeutatics will inform you, and are absolutely reliable."

You will note the attempt is made here to work in magnetism as a curative property. Except where steel magnets are concealed (of which I shall speak later), there is not one particle of magnetism produced by the action of a so-called electrical appliance of this class.

This is a point to which I wish to call special attention. Electricity properly controlled and applied is capable of wonderful effects in the relief and cure of a large number of diseases, and its legitimate use is increasing daily in the practice of the most enlightened and scientific practitioners of the age. In fact, hardly a practising physician of any repute can be found who has not his medical batteries, some of them costing hundreds of dollars, with all kinds of electrodes, some of which are as ingenious in construction as they are humane in purpose.

It is just this point that the swindlers of to-day lay hold of and turn to their own purposes. They designedly confound electricity and magnetism, and by a skilful interchange of terms they encourage in the public mind the same confusion. In many cases where they claim that magnetism is generated by their appliances, there is no magnetism at all; and in others where they claim that there is electricity there is magnetism. But this magnetism is not the result of any inherent virtue, it is the result of a smart piece of chicanery, in which the concealed magnet and the compass needle play the principal part. I claim, therefore, that in any event it is wrong and misleading to attempt to confound magnetism with the curative properties of electricity.

I have yet to learn the first case where magnetism, either strong or weak, has ever produced any effect either beneficial or detrimental upon the human system. Night after night for months I have been in the presence of the most powerful dynamos (as have thousands of men in the many electric light stations all over the world) where magnetism of the strongest kind permeates every bone and fibre and tissue of the body, and yet, so far as any effect either good or bad on the system goes, one would never know he had been in the magnetic field, and he would not notice it unless he found his watch stopped. To the best of my knowledge and belief there is absolutely nothing in the human anatomy that can be acted upon by a magnet. Of course, if a child swallows a mouthful of tacks or a paper of needles, there is something inside of the child upon which magnetism will act, but not otherwise.

What physician of any reputation has ever been known to attempt to apply magnetism, or to recommend the use of electric belts or the like? On the contrary, every reputable physician with whom I have talked on the subject has denounced them as worthless. Let us go a little further into this subject, and see how some of these things will bear the light of an investigation. We will first consider the so-called electric hair brush. I have thought best to purchase one of these brushes so that we can just see how they are made and to prove the assertion that so far as any curative property is concerned they are no better than any ordinary hair brush. I will first read an extract or two from the directions pasted in the box in which it comes:

"Cures headache in five minutes; cures neuralgia in five minutes; restores the hair, prevents baldness. The "Odic force" can always be tested by moving the brush near a compass. This power is so strong that if the compass is placed upon a thick book or table, and the brush is moved in a circle beneath the same, the power will pass through the intervening table or book, and cause the needle of the compass to rotate rapidly. A silver compass of considerable value accompanies each brush."

Now this brush I have does deflect the compass needle just as stated, but the real cause is very different from the ostensible one, and instead of any Odic force (whatever that may be) or any electricity having anything to do with its deflection, the statement is false, as I shall prove. I have taken pains to dissect the back of this brush, and we find just what we expected to find. Embedded in the material of which it is composed is a steel magnet. That, and that alone, is the cause of the compass needle moving towards the brush when brought near it. When I purchased this brush I was told that the movement of the needle proved that the brush was charged with electricity, and I have no doubt everybody else is told the same thing that buys one. You will notice this magnet is made of a piece of steel wire in the form of a double loop, and extends nearly to the end of the handle. The only electrical effect possible that can be produced by the use of this brush is static, and even under favourable conditions of the atmosphere, the greater part of such very small amount of static electricity as might be generated while the brush was being used would imperceptibly pass off the earth through the hand and arm and body of the user, leaving them no more benefitted by its use than if they had used any other hair brush.

Electric corsets are another deception. How is it possible, I ask you, for such a thing to be of the slightest use electrically to the wearer when they are not even worn next the skin. The magnetising of the steel ribs as is often done is of no use whatever as to any beneficial effect upon the wearer. Another of these precious frauds is the electric garter. I have seen advertisements, as no doubt many of you have, where the use of electric garters are guaranteed to give a more shapely form to the limbs of ladies. The absurdity of such an appliance is too apparant for comment, but it is really too bad to disappoint and deceive the ladies in a case like that. What swindle under the name of electricity will not be attempted next? Why don't they get up an electrical hat band guaranteed to supply a lack of brains, or furnish new ideas to those that wear them, yet would not such a thing be just as reasonable as some I have stated?

As an answer to some of the reckless statements which appear in advertisements and circulars, some of which I have mentioned, in regard to electric belts and other appliances, I will quote an authority and read some extracts from De la Rive's "Treatise on Electricity." De la Rive was, at the time of writing his work, a member of the Academy of Sciences, and also of Medicine, of nearly every large city in Europe, so that he is an eminently qualified authority to pass judgment on these appliances. After explaining the construction of

* Abstract of paper read by Mr. A. A. Knudson before the New York Electrical Society, December 30th, 1891.

the electro-galvanic chains and belts of Golberger and of Pulvermacher, he says:—

"We do not very well understand the effect of this arrangement by virtue of which the current is scarcely to circulate in the chain without traversing, at least in a very sensible manner, some part of the body. For not even a derived current can be obtained on account of the imperfect conductibility of the skin. Moreover, no very positive fact has proved the efficacy of this later mode of application, upon which experience has not yet decided. And again, we do not deny that there may be a production of currents in these apparatus; even the galvanometer indicates their presence; but they are very feeble currents; and we do not see what advantages can be presented by these arrangements which, at the very basis, rest on false ideas of the electricity of contact."

My wonder is, that the electrical journals have not been more outspoken in showing up these frauds upon the public. The public would naturally look to such a source for information of this kind, and these journals are not handicapped as others are by being paid for fat advertisements, for it is the uninformed public on electrical matters that they desire to reach; so they use the daily press and weekly and monthly publications to make known their wares. In summing up this whole matter of electrical appliances, it seems singular that they have been allowed to exist so long, especially the hair brush; one reason may be that the "public love to be humbugged"—but there is a limit to all things, and I predict, as electrical knowledge is being more and more disseminated by such institutions as Columbia College, it will not be long before people will understand the truth in regard to them.

Although I have touched upon but a few frauds and deceptions as practised in the electrical business, I am aware of there being many more which would prove interesting, were it not for the risk of tiring your patience. I have no doubt there are those in this audience who remember the electrical sugar refining frauds of a few years ago. Also the motors of Paine, which, for many years, continued to deceive people. Also much might be said of the tapping of telegraph wires leading to racecourses, and the ingenious electrical devices and methods for supplying stock quotations to bucket shops in Wall Street. Also some of the so-called telegraph schools, where young people are induced to pay their money, with the promise of a situation as soon as competent. This class of fraud cannot be too strongly condemned.

In concluding this paper, I cannot refrain from expressing a few words as to the position of the capitalist or investor in regard to new electrical inventions. In the few instances cited, I have endeavoured to illustrate how easy an investor may be deceived. It may be fairly asked by some, "Has the investor then no protection from the designs of a dishonest promoter, or from the mistaken though honest inventor?" I answer, he has. There are plenty of good, honest and capable engineers, in this and other cities, who, for a reasonable fee, will investigate and report upon any new scheme, if they are only applied to. Some of these engineers are peculiarly fitted to give advice and opinions in certain branches of this business, by reason of their long experience in such branches, while others have had experience, more or less, in all of them. Besides these individuals, there are now lately established in this city electrical firms, composed of men of unquestionable reputation and standing, who make it their business to investigate and report upon any electrical invention; and I claim that there is now no excuse of an investor being deceived where such facilities exist for obtaining correct information upon electrical subjects. Would a man afflicted with disease undertake to cure himself if he knew nothing of the study of medicine, or would a man, having an important lawsuit on his hands, undertake the management of his own case if he knew nothing of the practice of law? On the same principle, then, an investor takes a large risk if he depends on his own judgment while placing his money in alleged new electrical enterprises. On the other hand, the judicious investment of capital in electrical enterprises has brought large returns to a great many people, and in very many cases handsome fortunes have been realised. As an evidence of this fact, we have but to point to the marvellous success of the Bell telephone, also the electric light (both arc and incandescent), also the electric railway. Besides these great industries, there is no end of less important schemes, varying in value according to their commercial usefulness, and almost every day something new in the electrical line is being discovered.

In this paper I have endeavoured to interest you by pointing out the methods of unprincipled people in the electrical business, and I have also attempted to make clear the importance of investors seeking good advice before placing their money in electrical schemes. If I have succeeded in these two points then the prime object of my paper is effected.

The paper was followed by a very interesting and amusing discussion, in which Prof. Crocker, Dr. Laudy, and Messrs. R. W. Pope, T. C. Martin, and G. H. Guy participated. Several frauds and fakes were named, and Mr. Guy, as secretary, read a letter from one innocent who was being imposed upon by some persons advertising under the name of the society, and who recited a long list of swindles of which he had been the willing victim.

LONDON COUNTY COUNCIL.

THE meetings were resumed last Tuesday, after the Christmas vacation. The Highways Committee submitted the following:—

Woolwich Electric Lighting Order, 1891.

We have considered a letter from the Board of Trade, forwarding, for the council's observations, a copy of a letter from the solicitor of the undertakers under this order, applying for an extension by six months of the time within which to make the deposit of £1,000 as required by section 7 of the order; and we have also had before us a letter from the undertakers' solicitor, asking the council to assent to this application. We are of opinion that this is not a matter with which the council has any concern, and that it should be left to the Board of Trade to deal with. We therefore recommend that the Board of Trade be informed that the council has no observations to offer with reference to the application.

Notices under Electric Lighting Acts and Orders.

We have considered a notice from the House-to-House Electric Light Supply Company, dated December 31st, 1891, of intention to lay electric lighting cables from 103 to 109, Gloucester-road; and a further notice from the same company, dated January 4th, 1892, of intention to lay a cable in Evelyn Gardens. The works are of the usual character; and we recommend that the sanction of the council be given to the works referred to in the two notices, dated December 31st, 1891, and January 4th, 1892, respectively, of the House-to-House Electric Light Supply Company, upon condition that the company do give two days' notice to the council's chief engineer before commencing the work; that no pipes of a larger diameter than six inches shall be used; that the street-boxes shall be of the pattern approved by the council; and that, as an additional precaution against accident through defective insulation of the mains, each of the street-boxes shall be provided with an inner as well as an outer cover, the two insulated from each other as far as practicable, and that the outer cover shall be efficiently connected with earth.

The London Electric Supply Corporation has given a notice, dated January 2nd, 1892, of intention to lay distributing mains, consisting of lead-covered cables drawn into cast iron pipes, in Commercial Road, Stamford Street, New Cut, Waterloo Bridge Road, Belvedere Road, Edward Street, Vine Street, York Road, Lower Marsh, and Westminster Bridge Road. The proposed works are similar to those approved on previous notices of this company, and there is no objection to them; but as the traffic in Westminster Bridge Road is very great, we are of opinion that the works there should be carried out, when once commenced, as expeditiously as possible. We recommend that the sanction of the council be given to the works referred to in the notice, dated January 2nd, 1892, of the London Electric Supply Corporation, upon condition that the company do give two days' notice to the council's chief engineer before commencing the works; that the works in Westminster Bridge Road when once commenced be carried on continuously by day and by night until completed; that the mains be laid under the footways, and be kept 9 inches below under the side of the paving wherever it is found practicable to do so; that where the mains cross the carriageways they be kept at the same depth below the concrete or the road material as the case may be; that the positions of the street boxes, and the mode of construction of them, shall be submitted to and approved by the council's chief engineer; that all pipes or openings from or into the boxes shall be of such shape as to remove all risk of injury to the covering of the cables; that all cables crossing the boxes shall be supported from below in the boxes; that all service lines or small cables shall be protected, where leaving the boxes, by an extra lead covering or by wooden stoppers, and shall also have a copper wire of sufficient size carried from the service to the main cable, in good connection with the lead or iron outer casing; and that the ends of all mains terminating elsewhere than in a box shall be securely protected by iron caps, in addition to any other covering.

A notice, dated January 9th, 1892, has been received from the Kensington and Knightsbridge Electric Lighting Company, of a proposed extension of mains in Beaufort Gardens. There appears to be no objection to these works; and we recommend that the sanction of the council be given to the works referred to in the notice, dated January 9th, 1892, of the Kensington and Knightsbridge Electric Lighting Company.

We have also to report the receipt of the undermentioned notices, given in accordance with the resolution of the council to accept four days' (instead of one month's) notice in respect of the laying of service lines from mains already laid:—

From the London Electric Supply Corporation—December 18th, 1891, to 2, Deanery Street and 20, Southwark Street; December 30th, 1891, to 10, Borough High Street; January 8th, 1892, to Hudson's Depository, Wilton Road.

From the St. James and Pall Mall Electric Lighting Company—December 24th, 1891, to 6, New Burlington Street; December 30th, to 18 and 19, Coventry Street; January 5th, 1892, to Derby House, St. James's Square, and 127, Regent Street; January 7th, to 192, Piccadilly; January 12th, 1892, to 196, Regent Street.

From the Electricity Supply Corporation—January 13th, 1892, to 15, Suffolk Street.

The House-to-House Electric Light Supply Company has asked that four days' notice (instead of one month's notice required by the company's order) may be accepted by the council of intention to lay service lines from mains already laid. This concession has been made by the council to several other companies, and we see no objection to its being made in the case of this company also. We therefore recommend that the House-to-House Electric Light Supply Company be informed that the council will, until it gives notice to the contrary, accept four days' notice of the intention to lay service lines from distributing mains already laid; and that the Highways Committee be authorised to deal with such notices on behalf of the council.

REVIEWS.

How to Make Inventions. By E. P. Thompson. New York: D. Van Nostrand & Co. London: H. Alabaster, Gatehouse & Co., 22, Paternoster Row.

This book contains a great deal of good and very interesting reading, but whether it, or any other work, would have the effect of stimulating invention may be doubted. The assertion of the principle that "a belief of an individual that he himself does not possess genius or the power to invent is, in itself, a hindrance to the action of that power," is one of the truest statements ever made, we have ourselves, and probably many others have, again and again noticed it, not with reference to invention particularly but in matters of everyday life; to such people some stimulus is undoubtedly necessary, though we believe it would be less effective in developing inventors than in almost anything else. Physical strength to bear a continual strain is one very necessary element to enable success to be ensured, and this, we believe, will be found to be true of all successful inventors.

The initial step towards inventing, says the writer, is to analyse the problem into as many parts as possible, each of which parts has to be worked out separately. Now remarks of this kind, and similar ones which occur throughout the book, do not, it seems to us, really help an inventor appreciably. The author, in writing as he does, is really only analysing most elaborately the processes and steps which an inventor instinctively follows when he invents. A man, youth, or child, when he walks from one place to another, goes through a most elaborate series of motions, every part of the body is in movement. Now a writer who elaborately analyses and writes about all those movements can hardly be said to enable anyone to learn to walk better or quicker than instinct teaches him. Therefore, although what is written is very interesting reading no doubt, yet it does not appreciably help formal invention.

Decorative Electricity. By Mrs. J. E. H. GORDON. New and cheaper edition. London: Sampson Low, Marston and Co.

This work (to the original edition of which we have referred) undoubtedly contains many useful hints, but the illustrations are not altogether satisfactory; take, for instance, the illustration on page 99, "Imitation Sunlight," this is rather suggestive of "one of the deepest dungeons in the Bastille," and not of light and cheerfulness.

Data for Engineers, Surveyors, and Explorers. By RIDLEY HENDERSON. London: E. & F. N. Spon, 125, Strand.

This pamphlet of twenty-six pages is full of useful tables and matter, such as are continually being required by those engaged in surveying work. The type being small (but clear), the angular tables are compressed into very little space, the figures being worked out to five minutes of arc. Clear illustrations are given of the various cases of triangular measurement met with in practice. The only thing we have to complain of in the work is its price, which strikes us as being very excessive.

NOTES.

Personal.—At the meeting of the board of directors of the National Telephone Company, Limited, held last week at Oxford Court, Cannon Street, E. C., Mr. James Staats Forbes, one of the vice-presidents, was unanimously elected president of the company, in succession to the late Mr. Frederick Richards Leyland.

Obituary.—We regret to announce the death of Mr. Alexander Watt, who was so well known in connection with the electro-deposition of copper, and other metals. He was the author of several well-known books on this subject, and also on microphones; he was at one time editor of the *Electro-Metallurgist and Electric Light Journal*, and was also an occasional contributor to the *Forge and Lathe, Electrician*, and the ELECTRICAL REVIEW.

Pure Metals.—A recent investigation by A. Classen into the physical properties of pure bismuth has added fresh and important evidence of the fact, that however carefully metals may be prepared by chemical or metallurgical processes their purity cannot be compared with that of metals prepared electrolytically. Physicists are aware that the presence often of mere traces of foreign matter will alter the boiling point of a substance; and there is no surer test of impurity than that afforded by a determination of this constant. Here are some facts concerning bismuth which serve to illustrate our statement. Electrolytic bismuth as prepared by Classen *melts* at 264° Centigrade.

		C.
Sample 1.—	"Bismuth puriss," from Tromsdorff, melted at	271·8°
" 2.—	" " " " "	273°
" 3.—	"Absolutely pure bismuth," " "	265°—266°
" 4.—	"Bismuth puriss," from Schering " "	269°—270°

Commercial "pure" bismuth very frequently contains lead chloride and sometimes as much as 1·56 per cent. of copper and 0·45 per cent. of iron. These impurities cannot get into the electrolytically prepared metal; and such facts are cogent arguments in favour of using electrolysis whenever quantities of absolutely pure metal are required.

A Study of the Chemical Neutralisation of Acids and Bases by means of their Electrical Conductivities.—A summary of the results obtained on the above subject and already published, is given in the *Comptes Rendus*, cxiii., pp., 261—263, by D. Berthelot and will repay perusal and save much trouble in looking up the information at the different sources. Amongst the more recent results we may notice that potassium hydroxide, which is a strong base, gives with hydrochloric acid, acetic acid, or phenol compounds which have almost identical electrical conductivities; these behave as true salts, are stable in solution and are not decomposed by water. Ammonia, a feebler base, gives stable compounds with hydrochloric and acetic acids, but with phenol only an unstable compound which possesses a higher electrical resistance than the normal salts and is, to a large extent, decomposed by water. Aniline, a still feebler base, gives with hydrochloric acid a stable compound that is a good conductor; with acetic acid an unstable compound with a considerably higher resistance; and with phenol, only a non-conducting mixture possessing no trace of combination. Berthelot details a number of experiments with the hydroxy-benzoic acids, which are very interesting in so far as they bear upon this study.

The Lighting of Pontypridd.—On Friday at the usual meeting of the Pontypridd Local Board, there was an interesting discussion as to the advisability of illuminating the town by electricity. A joint deputation from the Pontypridd Chamber of Commerce and Ratepayers' Association attended for the purpose of impressing upon the Board the urgent necessity of taking immediate and practical steps with regard to the proper lighting of the town. The deputation petitioned the Board to either undertake the lighting of the town by electricity, or to purchase the gasworks. In the face of the miserable state of the public lighting, it was incumbent that something be done. A member of the deputation pointed out that in one of the outlying districts there had actually been no light for the past three weeks. The chairman remarked that the directors of the gas works had stated that in consequence of the extraordinary consumption of gas, they had experienced considerable difficulty in meeting the demand. They had also intimated that they purposed spending £20,000 in the purchase of new plant. A local board member expressed his opinion that partial lighting by gas and electricity would lead to serious complications. He agreed with the purchase of the gas works. Ultimately, it was decided that the gas company be written to and asked if they were prepared to treat with the Board for the sale of the works. In the event of the Board and the company being unable to come to terms, there will be no alternative but to resort to electricity, and it is stated that in view of the negotiations falling through several local capitalists are prepared to form a public electric lighting company. The matter is causing considerable interest in the district.

The Year Book of Science for 1891.—Messrs. Cassell & Co. announce that this annual is now in preparation.

The American Horse Market.—The *Street Railway Review*, of Chicago, contains a very interesting article on the condition of the American Horse Market. Our contemporary gives the opinions of several prominent horse-shippers, each of whom refer to the fall in the value of street car horses, and they all attribute this falling off in value to over-production, with the exception of one gentleman of long experience in raising horses, who personally told the writer of the article—quite unconscious as to whom he was speaking—voluntarily and at considerable length, his own opinion on the matter. "He primarily and chiefly blamed the rapid transit systems of cable and electric roads, which have knocked out thousands of horses of that grade," and he added with a sigh, "it wasn't apt to get any better very soon, as more roads were built every day." From this consensus of opinion, says our contemporary, the public may judge, making due allowance for the personal equation, which is always present even in mathematics, that the cervical vertebrae of the street car horse trade is irremediably fractured.

New French Customs Tariff.—The London Chamber of Commerce notifies the members of the electrical trade section that the following extracts from the new French customs tariff as definitely passed, to come into operation on February 1st, 1892, show the duties applicable on the articles mentioned under the general and the minimum tariff. It is understood that the latter tariff will apply to British goods :—

Tariff No.	Articles.	General tariff per 100 kilos.	Minimum per 100 kilos.
		Francs.	Francs.
361	Electric incandescent lamps provided with their accessories	400	350
361	Electric incandescent lamps without their accessories	800	700
524	Dynamo electric machines :—		
	1,000 kil. and over	30	20
	50 kil. to 1,000 kil.	45	30
	10 kil. and not over 50 kil. ...	100	80
536	Induction of dynamo electric machines and detached pieces, such as :—Bobbins full or empty in metal, surrounded by insulated copper; pieces worked in copper, weighing less than 1 kil., numbered and marked, fixed together or separate, for electrical apparatus, arc lamps, called regulators	100	75
576	Electric accumulators	17	13

The Institution of Electrical Engineers.—The next meeting will be held on Thursday, January 28th, 1892, at 8 p.m., by adjournment from the 14th, for the inaugural address of the president, Prof. W. E. Ayrton, F.R.S.

Street Lighting of New York.—The Gas Commission of New York recently opened the street-lighting proposals for 1892. The bidding for the 1,300 electric lights in the city by the interested companies was about the same as last year. The Brush Company offered to maintain 265 lights at from 40 to 45 cents a night for each light; the United States Company, 301 lights at 40 to 66 cents.; the East River Company, 266 lights at 40 to 60 cents; the Mount Morris Company, 154 lights at 40 cents; the Harlem Lighting Company, 195 lamps at 40, 45, and 50 cents; the Northern New York Company, 246 lights at 45 cents. The appropriation for lighting purposes for 1891 was $760,000. For the year 1892, owing to the increased number of lights, the cost is estimated at $804,000. The awards will be made after the bids have been compared.

Prize Projects for a Central Power Station.—Our contemporary, *Engineering*, says that the Société Industrielle, of Mulhouse, Alsace, offer a medal and a prize of one hundred pounds sterling for the best memoir on the subject of the distribution of power from a central station, having special regard to the industrial district of Upper Alsace. The 15th of next May is the last day for the reception of projects, which must be addressed to the president, La Société Industrielle de Mulhouse, Mulhouse, Alsace, Germany.

The French Atlantic Cable Company.—The *Daily Oracle* states that the news comes from Paris that the French Atlantic Cable Company has just received from the United States Government the much coveted and long sought for sanction to land its cable on the shores of the United States. Up to now this right has been steadily refused. By reason of the permission now granted, the company will be placed in direct communication with the Antilles and Brazil.

Electric Lighting in Kilkenny.—We hear that the Kilkenny Gas Company has decided to present a petition against the project for lighting the city by electricity, to carry out which a provisional order has been applied for by the Corporation.

Old Students' Association.—We have been asked to state that in accordance with the announcement made at the last annual dinner, Mr. Reginald J. Jones has been obliged to resign the hon. secretaryship of the Old Students' Association, owing to the pressure of professional work. The membership of the association is steadily increasing; last session 62 members and Associates were elected; while this session, up to December 31st, no less than 38 members and associates have been proposed for election.

Crystal Palace Exhibition and Railway Rates.—The London Chamber of Commerce recently approached the London, Brighton, and South Coast and the London, Chatham, and Dover Railway Companies with a view of securing a reduced rate on exhibits intended for the Electrical Exhibition at the Crystal Palace. The companies did not see their way however to grant reduced rates, but the Chamber has received letters in which the companies have agreed to convey the *unsold* exhibits on the return journey, free of charge, to any station on either of these lines of railway, provided that the exhibits remain the property of the exhibitors.

Electric Lighting in St. Pancras.—The Electricity Committee of St. Pancras made some interesting experiments in the early hours of last Saturday morning by testing the 12 arc lights placed along the centre of Tottenham Court Road. Prof. Robinson and Mr. Alderman Gibb accompanied the committee. After all the business houses were closed the electric light was first of all put on and the street lamps put out; then the case was reversed, and the contrast is said to have exceeded the most sanguine expectations, the 12 electric lights giving considerably more light than the 85 ordinary street lamps. On Saturday night the whole of the Brockie-Pell arc lights illuminated Tottenham Court Road, and in the course of a few days Euston Road, from Trinity Church to Euston Square, will be similarly illuminated.

City and South London Railway.—The traffic on this railway has for some months shown a steady increase over the corresponding periods twelve months ago. In view of providing for a further increase in the future, the directors of the company have instructed Messrs. Mather and Platt to design and construct another locomotive of considerably greater power and speed than the present locomotives. Owing to the exigencies of the traffic and the rolling stock being in consequence considerably heavier than was originally anticipated, and for which the present locomotives were not designed, they have been required to do far more work than that for which the makers constructed them, although some of them have run over 20,000 miles with the unexpected load without repairs of any nature whatever being required. Many of the delays which have occurred from time to time may be attributed to the overloading of the locomotives. It is to be expected that the action of the directors in increasing the power of the plant designed to meet the special circumstances, which twelve months' experience has fully disclosed, will, when fully completed, assure the more regular working of the line. It is most satisfactory that the steady increase in the traffic receipts should have encouraged the directors to pursue this forward policy which is greatly in the interests of electrical traction generally. The fourth dynamo of 400 H.P. constructed by Messrs. Mather and Platt for the generator station at Stockwell is ready for delivery, and the company are erecting the engine for driving the same.

Electric Lighting of Dublin.—We have on several occasions referred to the progress being made with the work of laying down the electric light mains in the streets of Dublin, and we had hoped that these operations would have been completed ere this, but we now learn from the *Irish Times* that "it is not probable that the electric lighting of the thoroughfares mentioned will be in operation before the month of May next, and even this will depend largely on the weather of the next six or eight weeks."

Jarrow Council and Electric Lighting.—The meeting of the Jarrow Council was held last week, when it was recommended that the Town Clerk be instructed to communicate with three or four of the principal electric lighting companies in the district, inviting them to apply for permission to supply the borough with the electric light.

The Electric Light at Fareham.—The charges for electric light in the Hampshire market town imposed by the Fareham Electric Lighting Company, formed the subject of some discussion at a special meeting of the Local Board last week, called to consider the draft of a provisional order about to be applied for by the company. Eventually the board decided not to oppose the company's provisional order.

Electric Lighting at Lynton and Lynmouth.—The electric light is now proving very reliable in Lynton and Lynmouth. Mr. Benn, the proprietor of the works, has just installed the light in the Devon and Cornwall Bank, as well as the manager's residence—the first private house in the neighbourhood in which the electric light has been adopted, and the result is, so far, very satisfactory.

Chester and Electric Lighting.—We understand that the Chester City Council has adopted the recommendation of the Watch Committee that a sum not exceeding £20,000 should be voted to provide a first installation of the electric light in the city.

Electric Light Company Opposed.—At a recent meeting of the Fulham vestry, the committee reported that, in accordance with the resolution of the vestry, they had instructed the solicitor to oppose the application of the Putney and Hammersmith Electric Light and Supply Company, Limited.

The Telegraph Service in the East.—Complaints are being made as to the irregular working of the Turkish telegraph line—especially those in Syria. It is said to be nothing unusual to send telegrams from Beyrout to Port Said by steamer.

Institution of Electrical Engineers' Dinner.—A dinner of the electrical engineers, who are members of the Whitehall Club, is to be held on Friday, the 29th inst., at the club. It is hoped that Mr. Tesla will be present, unless the postponement of his lecture from the 28th to February 3rd delays his arrival in London.

The Taunton Electric Lighting Company.—We understand from the *Somerset Express* that an offer has been made to this company for a six years' lease of the works commencing at £500, and rising £100 a year from the first year to £1,000.

Accident to a Telephone Man.—At Stanningley, on Monday afternoon, a Bradford man named Frank Conway, an *employé* of the National Telephone Company, was engaged doing some work at the top of one of the posts in Stanningley, when he by some means lost his hold and fell to the ground, a distance of some eight or ten yards. His legs struck across a wooden gate, and serious injuries were inflicted upon various parts of the body, but more particularly his thighs.

The Royal Society.—On Thursday, January 21st, at 4.30 p.m., the following papers, among others, are to be read: Major Cardew, "On a Differential Electrostatic Method of Measuring High Electrical Resistances. Prof. Schuster, F.R.S., and A. W. Crossley, "On the Electrolysis of Silver Nitrate in Vacuo."

Gas and Electricity.—After commenting upon the general outlook of the gas companies, our contemporary, *Money*, states: "There is no more need why electric light should be an enemy to gas than diamonds to gold."

Electrical Needs of the United States Government.—In an article under this heading, our American namesake states that of the amount of $409,000,000 required to pay the running expenses for the year commencing July 1st, 1892, a very considerable proportion will be expended for electrical appliances and services. The navy department will need a good share of the $1,000,000 estimated for the bureau of equipment, to carry out the plans for electric plants to be installed in the war vessels. The Naval Academy is wanting the electric light, as also are the National Soldiers' Home at Santa Monica, Cal.; the Interior Department; the Treasury Department; Government Hospital for the Insane; National Museum; and the Postmaster-General thinks that a few thousand dollars might be well expended in fitting up the electric light in the Post Office buildings.

Dundee Telephone Company and the Merchants' Morals.—In the Small Debt Court at Dundee last week, an action was raised by the National Telephone Company, Limited, Dundee, who sued John Milne and Sons, merchants and commission agents, Dundee, for £8 10s. being the year's subscription for the use of the telephone till November 15th next. The solicitor (Mr. Urquhart) stated that the defence was that his clients had insufficient service, and in reply the plaintiff's said that the defenders were not entitled to discontinue the use of the telephone until November, 1893, they having taken a lease until then. Mr. Urquhart asserted that the Telephone Company was responsible for half the profanity amongst the Cowgate merchants on account of the bad service given. The telephone was by no means improving their morals. After further discussion, the case was continued for proof, the Sheriff advising the pursuers' agent to so amend his summons so that it would include a claim for damages. We do not think that Dundee is the only place to which the remarks of Mr. Urquhart might apply.

The Lighting of Barnstaple.—The council of the Devonshire borough have had under consideration the application of the Gas Company to the Board of Trade for a provisional order. The gas company's directors had intimated that they were advised that clause 2 of the Electric Lighting Act of 1882, under which the council had proposed that negotiations for the purchase of the gas works should be entertained did not apply, and renewed their offer to sell at a valuation in the usual way. It was decided to present a petition against the granting of the provisional order, setting forth among other reasons for objecting to the order, that the local authority were of opinion that it is desirable that the lighting of the town, whether by gas or electricity should be in their control, and that they intended, with the approval of the ratepayers, to apply for an order.

A Curious Experiment with Ozone.—In some recent researches into the therapeutic and physiological effects of ozone, by MM. Labbé and Oudin, which are recorded in the *Comptes Rendus*, a curious experiment was made, which is worth a brief note. An ozone generator was used, which consisted of a closed glass tube containing rarefied air (which acts as one of the poles), surrounded by a tube, on the inner surface of which was a metallic thread. The space between the tubes was 3—4 mm., and across this space the sparks which produces the ozone were passed. Ten of these tubes were used, each being about 800 mm. long; they were placed in a laboratory of 300 cubic metres air space, and were actuated by an alternating current from a Gramme machine with a potential of 7,000 volts. The tubes having been placed vertically, the slight rise of temperature resulting from the discharge caused a continuous upward current of ozonised air which mixed with the unaltered air of the laboratory. After about a quarter of an hour the laboratory was filled with a bluish cloud of aluminium or aluminium oxide, and direct experiment showed that the electric discharge caused the volatilisation of weighable quantities of aluminium from the electrodes.

The Tramway and Railway World.—This is the title of a new technical London journal, which is to be published as a monthly review of current progress in steam, electric, cable, and other traction. The first number is imposing, interesting, well printed, and capitally illustrated, and electricity claims a fair share of its space. We believe there is room for such a periodical, and in wishing it a successful future, we trust that it may be the means of helping forward the best, simplest, safest, and most economical of all modes of traction, viz., the electrical.

Progress of Mr. Tesla's High Frequency Work.—The *Electrical World* says: "During the past six months, Mr. Nikola Tesla has been steadily at work developing the beautiful principles that he enunciated in his striking lecture before the American Institute of Electrical Engineers. In his skilful hands the experiments have extended far beyond their merely theoretical importance in the direction of important practical applications. Part of the fruits of his industry has already appeared in his method patents on incandescent lighting, another patent on condensers, and divers applications that are now in the Patent Office. Many of the practical difficulties that at first appeared have been overcome, and we may ere long see the results in commercial work. Meanwhile the transmission of power has not been forgotten, and some interesting improvements in that line may soon be expected, especially as the use of the methods embodied in Mr. Tesla's early patents has recently made such a sensation abroad. About the middle of January, Mr. Tesla expects to sail for Europe to deliver, at the urgent request of his English friends, a lecture on his high frequency researches, and to look after his foreign interests generally. The trip will be a flying one, of only a couple of months, as the pressure of work at home forbids a long absence. On his return, some of the latest commercial developments of his work may be expected to appear as promptly as circumstances will permit. The revolutionary character of his methods will make any extensive application of them of unique interest.

Chicago Exhibition, 1893.—The Royal Commission for the Chicago Exhibition are endeavouring to form a typical collection illustrating British metallurgy for the British section, and they are now applying to owners and managers of metallurgical works asking for specimens of each of the principal metallurgical products produced at the works, and also for specimens illustrating various processes. At the close of the Exhibition the collection will be presented to an American museum, so that it will have a permanent value.

Society of Arts.—On Monday next, at 8 p.m., Prof. George Forbes, F.R.S., will deliver the first of four Cantor lectures on "Developments of Electrical Distribution."

Electric Transmission of Power in Switzerland.—The water-power of the Mühbruch at Belp, near Berne in Switzerland, is now being transmitted to the Bay cloth factory, a distance of about six miles.

Tonbridge Local Board and the National Telephone Company.—A committee has been appointed by the Tonbridge Local Board, to consider the advisability of opposing the bill of the National Telephone Company, which is about to be placed before Parliament. The Board have taken on the initiative of the Local Boards Association who urge opposition.

Telephones in Norway and Sweden.—Telephonic communication was recently held between Cederslund and Lund, in Sweden, a distance of about 800 miles. The governments of both Norway and Sweden have each made a grant of a sum of money towards the establishment of telephonic communication between Christiania and Stockholm.

Telephones in Italy.—A telephone exchange system in the town of Brindisi was put into operation on the 1st inst.

Electric Tramways in Boston, U.S.A.—The traffic on the tramway lines of the well-known West End Railway Company, of Boston, U.S.A., has so greatly increased that 175 additional cars are to be put in operation before the 1st prox.

The Electric Light in Austro-Hungary.—It is proposed to establish a central electric station to light the town of Holleschau in Austro-Hungary.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electric Welding Company, Limited.—The annual return of this company, made up to the 5th inst., was filed on the 14th inst. The nominal capital is £460,000, divided into 45,000 ordinary and 1,000 founders' shares of £10 each, 25,000 ordinary and 617 founders' shares have been taken up, and upon 16,667 ordinary shares £6 per share has been called, while upon the founders' shares the full amount has been called; 8,333 ordinary shares have been issued as fully paid. The calls paid amount to £70,726 10s., and unpaid to £102,113 10s. Registered office, 6, Great George Street, Westminster, S.W.

Electrical Advertising Syndicate, Limited.—The statutory return of this company, made up to the 29th ult., was filed on the 12th inst. The nominal capital is £10,000 in £10 shares, 907 of which have been taken up, and £9,070 has been paid. Registered office, Victoria Mansions, Victoria Street, Westminster.

Electric Fittings, Hiring and Maintenance Company, Limited.—The first registered office of this company is situate at 9, Austin Friars, E.C. (filed on the 12th inst.)

BUSINESS NOTICES, &c.

Preston Electric Lighting.—It is not generally known that during the last twelve months the electric light has been installed in many of the public buildings, shops, and residences in Preston. A temporary generating station was fixed twelve months ago for the purpose of ascertaining what inclination the people of Preston had for the electric light. The National Electric Supply Company, Limited, which company has obtained a provisional order for lighting the town for a term of 42 years, intended that the maximum output for this station was to be only 1,000 8-C.P. lamps, but long before the plant was working the amount of lamps was greedily taken up on a basis of 12s. per lamp per annum. The company, to meet additional orders, were compelled to fix another machine, bringing the capacity up to considerably over 2,000 lights, which quantity is now actually working, and orders for more daily coming in; but with the before-mentioned plant it is impossible to execute further orders. They are therefore being filed for future connection from the central generating station which the company have now commenced to erect. The outside wiring, up to now, has been overhead, there being four circuits from the central station in Corporation Street, two along pole routes through the most important thoroughfares in the town, and two over house tops, telephone fashion. The whole of the wires and cables for this installation have been manufactured by the Northern Electric Wire and Cable Manufacturing Company, Limited, Halifax. The present plant, supplied by Messrs. Blakey, Emmott and Co., Limited, of Halifax, consists of three dynamo machines of 18,000 watts, and a dynamo of 30 kilowatts has been specially designed for this station. It gives an output of 140 volts and 430 amperes at 350 revolutions per minute. The magnetic system is octagonal in shape with four internally pointing poles. The yoke is of the best cast iron, and the magnet bars of wrought iron. The four magnet coils are wound upon four metal formers with brass cheeks, and can be readily removed or put in place. The armature is the cylinder type, and is built up of thin charcoal iron washers, carefully insulated from each other and mounted on a gun metal spider. The diameter of the armature core is 21 inches. It is insulated with mica before being wound. The windings are laid on Gramme fashion, and consist of 200 turns of copper tape in 100 sections of two turns each. Nine driving horns of stiff vulcanised fibre are provided which run the whole length of the armature. The windings are securely held in place by bindings of phosphor bronze wire. The commutator is made up of hard drawn copper bars insulated with mica, and is carried upon the shaft by means of brass rings and fibre insulation. The armature connections are soldered to spokes projecting from the commutator segments. These spokes are afterwards covered by a disc of thin fibre, which not only prevents dust from lodging, but also promotes a strong draught through the armature from the pulley end and expels it at the commutator. Four sets of three brushes each are used mounted on an adjustable rocking frame. The brushes are connected by four separate connections to the terminal boards. The brushes are of gauze. The shaft is of Bessemer steel, and runs in long bearings of gun metal. Sight feed lubricators and oil-draining arrangements are provided. The magnet yokes divide in a horizontal line, and by raising the top half of the magnets the armature can be examined in place. This dynamo runs entirely without sparking or overheating, and notwithstanding the magnets are only shunt wound the lead given

to the brushes has only to be altered a few degrees for any output from no load to full load. The machine is the usual 90 kilowatt or 3,000 lamps of 8 C.P. run at its ordinary speed of 500 revolutions, at which output it has an electrical efficiency of 97 per cent., and a commercial efficiency of over 93 per cent. For this output the armature is drum wound with special end connections. The National Electric Supply Company, Limited, now propose to put down a plant on the low tension system similar to that now working so successfully in the St. James's district in London, which Messrs. Latimer Clarke, Muirhead & Co. have pioneered. The first portion of the town to be served from this station will be the compulsory area, with the adjoining streets, in which it is sanguinely anticipated that a demand for at least 20,000 8-C.P. lamps will be made. Distributing boxes will be laid to such places so as to ensure an even potential over the mains. A large number of meters have been successfully introduced, and it is the intention of the company to continue the supply. The amount charged to consumers is 8d. per Board of Trade unit, with a discount of 15 per cent. if paid within twenty-one days. It is stated that this compares very favourably indeed with the cost of Preston gas, which by-the-bye is 2s. 9d. net, and of very bad quality. Preston with its numerous mills is favourably placed for a successful adoption of the electric light, and the way in which the present engineer and manager, Mr. F. F. Bennett, has worked up the present installation augurs well for the future.

Central Station Lighting in Halifax.—The Halifax Mutual Electric Light and Power Company, Limited, are continuing to do good work in the way of public lighting in the town of Halifax. It is nearly two years since this company was formed by taking over the central station, then being worked by Messrs. Blakey, Emmott and Company, Limited, and also that of an opposition company which has since ceased to exist. The wires, by permission of the Halifax Corporation, are all overhead, and the company is supplying current for about 60 arc lights of 10 ampères, and 1,000 incandescent lights of 8 C.P. Two systems of charging are adopted in the town, viz.:—one at the rate of 12s. per 8 C.P. lamp per annum, and £12 per 10 ampère lamp per annum, and at 8d. per B.T.U. The furthest point served from the central station is about 1,700 yards. The low tension system is adopted throughout. It has been found during the past two months that the company could not keep pace with the large demand for current at their present premises, therefore negotiations have been entered into with the Halifax Corporation for leasing from them a convenient site, and very shortly it is hoped that the company will have a capacity of at least 20,000 8 C.P. lamps. Two systems of engines are used for driving, viz.:—Armington-Sims high speed, and Tangye's. The dynamos and all other electrical fittings in connection with the installation are of the well known Blakey-Emmott type, and Mr. Walter Emmott, of Blakey, Emmott and Company, Limited, is the managing director. The meters adopted up to the present have been the "Aron," and appear to be giving general satisfaction both to the company and with the consumers. The price per 1,000 cubic feet of gas in Halifax is 2s. net, and judging from the weekly reports of the expert who tests the illuminating power on behalf of the ratepayers, the average illuminating power is about 17 candles. Taking into account the very low figure with high efficiency of gas, it speaks very well for the prospects of electric light for the future when the present output and very large demand for current is considered. The whole of the wires and cables for this installation have been manufactured by the Northern Electric Wire and Cable Manufacturing Company, Limited, Halifax.

B. Verity and Sons.—Having entered into contracts for a number of years for the supply of telegraphic instruments to three of the leading English railway companies, Messrs. Verity and Sons have opened a special department for this work at their Birmingham factory, and intend to make a speciality of this branch of electrical business. At the same time they are not allowing their fittings' manufactory to stand idle, for in addition to numerous orders for the electrical trade, they have just completed a set of very pretty chased floral brackets of a new design for the Right Honourable Lord Hartington, now Duke of Devonshire, to be fixed at his Eastbourne house. Amongst other work for private residences may be mentioned some magnificent fittings in mercurial gilt for Mr. Hamar Bass, M.P. Messrs. Verity's Birmingham house was lately called upon at a very short notice to produce a number of special fittings for the new Pullman cars of the South Eastern Railway, and though made to special design was able to carry out the order satisfactorily. By the number of orders now arriving from Australia, Hong Kong, and Bombay, it would appear that the electrical trade in the East is at length waking up. There seems to be every prospect of South Africa affording a great field for electrical enterprise in the near future. At the present time the theatre at Johannesburg is being fitted up with a complete electric light installation. The fittings are being manufactured by Messrs. Verity, who are supplying amongst other brass-work a handsome 50-light electrolier.

Tenders Wanted—Durban.—We are now in a position to give further particulars regarding the tenders which the Durban Town Council are at present inviting for the electric lighting of the town. The Durban Town Council is prepared to grant concessionary rights to an undertaker for the establishment of electrical conductors for the supply of electricity to the town of Durban. Tenderers must be prepared to put down all necessary plant and conductors at their own cost, and must state the price at which they will be prepared to supply electricity to private consumers. The Town Council is prepared to make an annual payment for the lighting of all the public streets, roads, and pleasure grounds by electricity. Tenderers will be required to state the payment they would require. There are no public gasworks at Durban. The Corporation will lease suitable sites for electrical stations at a nominal rent. There are about 3,000 buildings within the lighting area of the town. The population of whites is about 12,000, and of Indians and natives about 12,000. Printed conditions, with plans of the town, may be obtained on application to Mr. W. H. Radford, C.E., consulting and representative engineer to the Durban Corporation, Angel Row, Nottingham. Tenders to be forwarded to the Town Clerk, Durban, Natal, and endorsed "Tenders for Electric Lighting," and such tenders must reach the Town Clerk by April 30th.

King, Brown and Company.—The Jarrow and Hebburn Co-operative Society having decided to illuminate their magnificent new central store, now rapidly approaching completion, in Market Square, Jarrow, with an installation of the electric light, have placed the contract in the hands of Messrs. King, Brown & Co., of Edinburgh, who have successfully carried out several large Government and other contracts, including several of Her Majesty's ships, amongst these the *Sybilla*, now being fitted out in the Tyne. Not the least successful of their work was the illumination of the Waverley Market, with its 2,000 lights, on the occasion of the New Year's carnival in Edinburgh.

Tenders Wanted—Waterford.—For the public lighting of part of the city at present lighted by electricity, and also in the alternative for the public lighting of the entire city, either by gas or electricity, for periods of two, five, or ten years, from September 1st, for the Public Lighting Committee. Tenders to be sent to Mr. Joseph W. Howard, Town Clerk, by February 1st. All information can be obtained at the office of Mr. M. J. Fleming, Borough Surveyor, The Mall, Waterford.

Electric Lighting and Refrigerating Machinery.—We understand that the Electrical Engineering Company of Ireland, Limited, Dawson Street, has contracted with Messrs. E. Hodgins and Co., victuallers, William Street, Dublin, to provide a complete installation of electric light throughout their premises, and to furnish a freezing plant suitable for the business, the whole to be in readiness during the coming spring. The total cost is estimated at close upon £1,000.

Laing, Wharton and Down.—Referring to the recent removal of the offices of the Laing, Wharton and Down Construction Syndicate, Limited, to 38, Parliament Street, Westminster, we are requested to state that this change in no way relates to the old established firm of Laing, Wharton and Down, whose address remains the same, with the addition of branch and city offices at 17, Gracechurch Street, E.C.

New Business.—In consequence of the winding up of the Institute of Medical Electricity, Limited, Mr. H. Newman Lawrence has opened rooms at 36, St. Martin's Lane, W.C., and at his private residence, 29, Finborough Road, Redcliffe Square, South Kensington, S.W., where he will continue to treat patients by electricity and massage as heretofore.

Tenders Wanted—Nottingham.—Persons desirous of tendering for the lighting by electricity of the rooms which formerly constituted the old kitchens at the Castle Museum are invited to send to Mr. Sam. Geo. Johnson, Town Clerk, sealed specifications and tenders. Mr. G. H. Wallis, the curator, will show the rooms.

New Firm.—The business lately carried on by Messrs. Hollington Bros., at Arnold Road, Bow, London, has been purchased by Mr. V. G. Lironi (late of Messrs. Woodhouse and Rawson, and the Ellison Electric Company) and Mr. J. J. Bowman, of Newport, Mon.

Price List.—We have received from Robert Garrard and Co., of Bethnal Green Road, a copy of their revised price list of cable casings. The firm have a good stock, and are therefore able to execute orders on receipt.

Calendars, &c.—We have received from the Commercial Cable Company one of their calendars for the present year; also from Messrs. Barnes and Low one of their calendars for the year 1892.

The Electric Light in Chancery Lane.—Messrs. Laing, Wharton and Down are putting down an installation of the electric light at the Lonsdale Buildings in Chancery Lane.

CITY NOTES.

St. James's and Pall Mall Electric Light Company.

IT is with some reason that this company has been pointed out as the most flourishing of electric light companies in England. Still more will the force of this reason be apparent when the latest report of the company is considered. The earnings of the company justify the directors in declaring for the half-year a dividend of 10 per cent., making for the year a dividend of 8½ per cent. This is satisfactory even without taking into account the former dividend for the year 1890 of 5 per cent. A noticeable paragraph in the report is that which states that the site has been secured for a a second central station, and another which is sanguine that th station will be completed during the next summer. Expenses ha been kept at a low figure, and there seems to be a strong desire work with the greatest economy.

Direct United States Cable Company, Limited.

THE twenty-ninth ordinary general meeting of this company was held on Friday last, at Winchester House, Old Broad Street, E.C., Sir John Pender, K.C.M.G., presiding.

The SECRETARY (Mr. T. Finnis) read the notice convening the meeting.

Before proceeding with the business of the meeting,

The CHAIRMAN said that as their meeting was constituted, he thought they would all agree with him that they ought to give expression to a deep and warm sympathy in the great bereavement which the Royal Family had sustained in the death of the Duke of Clarence. He believed that the deep sympathy was universal.

The SECRETARY then read the minutes of the last meeting, and

The CHAIRMAN said that he presumed they would take the report as read. Before asking them to approve of it he would, as usual, go over some of the details and figures of the report, so that they might have a more complete knowledge of the working of their system during the last six months. The revenue for the half-year to December 31st last, after deducting out-payments, amounted to £45,402, and the working and other expenses, including income tax, but excluding cost of repairs, £17,672, leaving a balance of £27,729 as the net profit of the half-year, making, with £3,502 brought forward from the previous half-year, the total of £31,231, which had been appropriated as follows:—Interim dividend of 3s. 6d. per share for the quarter ended September 30th, 1891, £10,624; interim dividend of 3s. 6d. per share for the quarter ended December 31st, 1891, £10,624; amounts set aside to reserve fund, £5,000; balance carried forward, £4,983—total, £31,231. The revenue, as compared with that in the corresponding period of the previous year, showed an increase of £2,055, but the traffic generally had not been so brisk. The McKinley tariff had no doubt restricted trade in many quarters, and but for the large operations in grain, the company's revenue probably would have shown a falling off. The expenses in London were as follows:—Increase of £129 in salaries and £13 in office expenses, and a reduction of £23 in printing and stationery, the remaining items being practically the same as previously. The expenses at stations showed an increase of £325 in salaries, wages and allowances, and £63 in rates and taxes and the reduction of £40 maintenance, £21 travelling expenses, and £78 in repairs and renewals, and £31 in printing and stationery. The expenses on the whole showed an increase of £291, largely due to the new branch at New York which the chairman referred to at the last meeting. A reduction of £259 was shown in insurance and storage of cable, while on the other hand an amount was written off for spare cable. The reserve fund had been discharged of £4,478 for cost of repairs to cables. At the same time it had been credited with £4,303 interest on the investment, and, with £5,000 from the revenue, increasing the balance of reserve to £259,680 8s. 8d. Their investments remained unaltered from the last half-year, and the present market value continued considerably in excess of the cost of same to the company. These were the hard facts connected with the last half-year, and in looking over the remarks that he made when he addressed them six months ago, he thought that he told them then everything that he could possibly bring before their notice that would interest them. He had very little further to say than that they were going on fairly well. The McKinley business, to which he had already referred, rather interfered with them, although that had pulled up by the increase in the carrying of grain, and also in the general movements in America at the present time of railway stocks, and, as he had often said whenever there was a movement in that way, they always got some share of it shown in their returns. There was no doubt also that the preparation for next year's exhibition would help them to some extent, but they had still got this fact to face that there were rather more cables in the Atlantic than were required to do Atlantic work, and until such a growth of telegraphy comes to fully employ those cables, he did not think they could look forward to any large increase in their returns. They saw the newspapers, and doubtless asked themselves why this should be so. The Commercial Cable Company shares were at present selling at somewhere about £150. He believed there was very little indeed of that stock held in England; there was a good deal held in Canada, but it was held in a few hands, and they might just as well make it £200 as £150 so far as the general public were concerned. He could not see any reason why that company's stock should be at that price; the stock of the Direct United Company was about half that amount. The Commercial Company with their £150 pay 7 per cent. upon the nominal capital, but taking it at the advanced price, it only gave to men buying it to-day £4 13s. 4d. Any man buying the Direct United stock had 50 per cent. discount, or very nearly; they were paying 3½ per cent. upon their par value of £20, so that the man buying their stock received practically 6⅔ or 7 per cent. for his investment, as against 4½ per cent. in the other company's investment. That was a very striking feature. The Direct Cable Company had carried messages in the shortest time. They had carried the news of the Derby at one time, from London to New York, in less than one minute, and they could not beat that very much. They were working seven cables against the Commercial Company's two cables, and they knew that a great deal depended upon their rapid carrying power, thus these extra cables enabled them to do the traffic quicker than it could be done by any other company; therefore he held that there was no reason that he could see, excepting a certain amount of prejudice or "rigging," that they had "rigged" the price up to this point, but if the shareholders took his advice, he would say rather invest and get 7 per cent. out of something which might rise to par, than invest in something which might go down to par. During the last six months they had had one repair, and he was glad to say that in that repair they brought up cable which gave them very great satisfaction, in seeing that their cable was in splendid condition, although it had attained the age of 17 years. He thought it had a number of years before it, and their belief in the life of cables was growing. They always promptly repaired their cables; they never lost an hour, but if a cable broke down they sent out a ship at once. That had not been the case with their companies generally, but they thought it well that interruptions should be put right immediately, or as soon as possible. He hoped when he saw them next time that he would be able to tell them that they were going on satisfactorily. He did not think there was such good property as their's out of which they could get 6½ or 7 per cent. With these remarks, he moved that the report of the directors, dated January 5th, 1892, together with the statement of accounts to December 31st, 1892, annexed thereto, be received and adopted.

This was seconded by Mr. WM. FORD, and carried unanimously.

The CHAIRMAN stated that they were still dragging on with the French suit; he supposed it would come to an end some time, but as to when that would be was a very difficult matter to say.

A piece of the cable referred to was here handed round for the inspection of the shareholders.

A vote of thanks to Sir John Pender for presiding was proposed by Mr. BROWN LOW. This was seconded and carried, and the chairman having replied thereto the proceedings terminated.

St. James's and Pall Mall Electric Light Company, Limited.

THE directors' report for the year ending December 31st, 1891, states that in submitting their annual report for 1891, with accounts as certified by the company's auditors, the directors congratulate the shareholders on the satisfactory progress made by the company during the past year. Early in 1891 the capital of the company was increased from £100,000 to £200,000 by special resolution of the shareholders creating 20,000 7 per cent. preference shares of £5 each. Of these shares 10,000 were issued to the shareholders at par, and fully subscribed for by them in March. The balance of 10,000 shares was issued in December last at 30s. per share premium, and duly allotted to the shareholders. This last issue of shares placed £15,000 at the disposal of the directors as a capital reserve fund. The £15,000 has since been invested in 2½ per cent. annuities, and is shown in the accounts annexed hereto. The attention of the directors has been largely directed during the year to the purchase of land for and the erection of a northern station. Owing to the congested condition of the parish and the extreme scarcity of available ground, this proved to be a difficult matter. The directors, however, are pleased to be able to report that they have secured a suitable freehold site in Carnaby Street, Regent Street, and have entered into a contract for the erection of the building on designs prepared by Mr. C. Stanley Peach, F.R.I.B.A. A considerable portion of the machinery and boilers required for this station have already been constructed, and it is hoped that during the summer of this year the station will be finished and in working order. There are certain compulsory mains which have to be laid in the parish before August next. These, with other mains which the board deem necessary to complete the system, will be proceeded with without loss of time, and there seems every reasonable probability of the whole of the work being completed without any further capital being required. It may be of interest to the shareholders to know that the two stations will be connected by a grand trunk main, about half of which is already completed and laid. This will be a means of enabling the northern station to support the southern in case of necessity, and *vice versâ*. The system adopted by the company has worked thoroughly well during the whole of the year, and the directors are satisfied that it is the best that could be selected, having regard to present knowledge. The experience gained at the company's works enables the company's officials to make improvements from time to time, and no precaution is neglected to maintain the excellent results hitherto obtained. The net earnings of the company during the past year have amounted to £10,395 12s. 5d. Of this sum, £3,610 6s. 4d. was distributed in July last in payment of an interim dividend at the rate of 7 per cent. per annum for the half-year ending June 30th, 1891, on the ordinary shares, and on the instalments paid on the first issue of preference shares. The balance of £6,785 6s. 1d., added to £315 12s. 9d. (the undivided profit from last year's account), leaves £7,100 18s. 10d. now to be dealt with. The directors propose to divide this amount as follows, viz.:—

	£	s.	d.
(*a*) By payment of a dividend at the rate of 7 per cent. per annum calculated on the instalment paid on the first issue of 10,009 preference shares for the second half of the year	1,333	6	8
(*b*) By payment of a dividend at the rate of 10 per cent. per annum for the second half-year on the ordinary shares, making with the interim dividend paid in July last a total distribution of 8½ per cent. for the year	4,670	0	0
(*c*) By paying a dividend of £10 15s. per share on the founders' shares	1,075	0	0
(*d*) Amount to be carried forward to ordinary shareholders undivided profit account	6	2	6
(*e*) Amount to be carried forward to founders' undivided profit account	16	9	8
	£7,100	18	10

The directors have carried £1,000 to "redemption account" to commence a fund, to accumulate by annual additions, to represent loss of capital at the expiration of the term covered by the provisional order

The directors are advised that the amounts provided in the accounts for depreciation are sufficient and ample for all purposes. Two of the directors, namely, Messrs. Egerton H. Clarke and H. Woodburn Kirby, retire, under clause 79 of the articles of association, and, being eligible, offer themselves for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., also retire, and, being eligible, offer themselves for re-election.

ABSTRACT OF ACCOUNTS TO December 31st, 1891.

CAPITAL ACCOUNT.

Dr.	£	s.	d.
To Expenditure per last account	92,126	18	2
„ Further expenditure to December 31st, 1891 ...	47,331	3	9
„ Balance	15,541	18	1
	£155,000	0	0

Cr.	£	s.	d.
By Ordinary shares	93,400	0	0
„ Preference shares (20,000 of £5)	55,000	0	0
„ Founders' shares (100 of £1)	100	0	0
„ Debentures (6 per cent. mortgage)	6,500	0	0
	£155,000	0	0

REVENUE ACCOUNT.

Dr.	£	s.	d.
To Generation of electricity ... ... } „ Distribution of electricity ... ... }	11,187	13	2
„ Proportion of rents, rates, and taxes	779	17	7
„ „ of management expenses	3,624	0	1
„ „ of law and parliamentary charges ...	558	14	7
„ Special charges, depreciation, redemption fund ...	5,186	2	7
„ Balance carried to net revenue account	10,562	6	10
	£31,898	14	10

Cr.	£	s.	d.
By Sale of current per meter	30,934	14	4
„ „ „ under contract	215	3	6
„ Rental of meters, converters, &c.	362	2	11
„ Transfer fees	117	9	6
„ Other items	269	4	7
	£31,898	14	10

NET REVENUE ACCOUNT.

Dr.	£	s.	d.
To Interest on debentures and calls	456	18	8
„ Balance	10,711	5	2
	£11,168	3	10

Cr.	£	s.	d.
By Balance from last account, less 5 per cent. dividend on ordinary shares	315	12	9
„ Balance from revenue account	10,562	6	10
„ Interest on money at deposit	290	4	3
	£11,168	3	10

RESERVE FUND.

Dr.	£	s.	d.
To Balance	15,000	0	0
	£15,000	0	0

Cr.	£	s.	d.
By Premium of £1 10s. per share on preference shares in December, 1891	15,000	0	0
	£15,000	0	0

GENERAL BALANCE SHEET.

Dr.	£	s.	d.
To Capital account	155,000	0	0
„ Sundry tradesmen and others, on construction of plant, machinery, fuel, &c, ...	902	10	2
„ Sundry creditors on open accounts	1,065	5	11
„ Reserve fund account	15,000	0	0
„ Net revenue account, balance at credit thereof less interim dividends on ordinary and preference shares	7,100	18	10
„ Unclaimed dividends, calls paid in advance „ Depreciation fund ... ... „ Redemption fund	16,272	7	3
	£195,341	2	2

Cr.	£	s.	d.
By Capital account	139,458	1	11
„ Cash at bankers	28,726	8	1
„ „ in hand	29	2	5
„ Sundry debtors for current	9,852	13	3
„ Other „	54	0	6
„ Stores on hand	2,220	16	0
„ Capital reserve fund investments 2½ per cent. annuities	15,000	0	0
	£195,341	2	2

The City of London Electric Lighting Company, Limited.

As agreed at the statutory meeting of this company, the directors have decided to allot the whole of the 9,848 ordinary shares of the company at 5s. per share premium, *pro rata*, to shareholders on the register on January 14th, 1892. The first payment, of £3 5s. per share, will be due on 23rd inst. The second payment of £3, will be due on February 1st next, after which date the shares now to be allotted will rank *pari passu* in all respects with the existing shares.

The following is an abstract of the directors' report regarding the progress made by the company:—

Generating Stations.—These are two in number, viz., at Meredith's Wharf, Bankside, and at Wool Quay, Lower Thames Street. From each of these the supply of current has been commenced, and the erection of additional generating plant is being actively proceeded with.

Public Lighting.—Queen Victoria Street, Gracechurch Street, King William Street and Cornhill are already lighted, and the work is so far advanced that the lighting in many other of the main thoroughfares of the City will be commenced in a few weeks.

Street Mains.—In consequence of the exceptional facilities granted by the Commissioners of Sewers since their meeting of December 1st last, the opening up of the main thoroughfares has proceeded very rapidly, and the present rate of progress is about a mile a week. This will enable the company to reach the best paying districts of the City at an early date, and the earning of a substantial revenue will consequently be materially hastened.

Private Lighting.—The Mansion House was lighted from the company's mains in December last. Since then the engineering staff has been continuously employed in connecting the premises of further customers. Signed applications for about 13,000 lamps have been already received, and are being added to at the rate of 1,500 a week. Informal applications for a large additional number have also been made.

Revenue.—For obvious reasons it is necessary when establishing an electric supply station to provide a staff out of proportion to the amount of current at first delivered. In spite of this drawback, however, Mr. David Cook, the company's recently appointed manager, reports the revenue already being earned to be in excess of the current expenditure at the generating stations.

There is therefore every prospect of a rapid growth in the company's net income.

Anglo-American Telegraph Company, Limited.—At a meeting of the board of directors of the Anglo-American Telegraph Company, Limited, held on Friday, it was resolved to recommend to the proprietors at the next half-yearly general meeting of the company to be held on January 29th next, the declaration of the following dividends:—1. A balance dividend of 16s. per cent. upon the ordinary consolidated stock for the year ending December 31st, 1891. 2. A balance dividend of £1 12s. per cent. upon the preferred stock for the year ending December 31st, 1891, both payable on January 30th next, less income tax, to the stockholders registered on the books of the company on the 12th inst. After paying the foregoing dividends there will be a balance of £864 to be carried forward to the next account. The above dividends, together with those already paid, will amount to £2 12s. per cent. on the ordinary consolidated stock and £5 5s. per cent. on the preferred stock for the year 1891. The register of transfers will be closed from January 15th to January 29th, both days inclusive.

The Brush Electrical Engineering Company, Limited.—The directors of the Brush Electrical Engineering Company have declared an interim dividend upon both the ordinary and preference shares of the company at the rate of 6 per cent. per annum for the six months ended December 31st last, payable on February 15th next. The transfer books of the company will be closed from the 20th to the 27 instant.

The Simplex Electrical Syndicate, Limited.—A general meeting of this company will be held at 4, Hercules Passage, Threadneedle street, E.C., on February 16th, 1892, at 3 o'clock, for the purpose of having laid before it an account showing the manner in which the winding up of the syndicate has been conducted and its property disposed of, and for the purpose of hearing any explanation that may be given by the liquidator.

Electric Hiring, Contract, and Maintenance Company.—We have received a copy of a letter from the Electric Hiring, Contract and Maintenance Company, intimating that in consequence of enquiries to that effect, arrangements have been made whereby one founders' share will be allotted to every applicant for 50 ordinary shares, which seems to be put forward as an inducement to applicants to subscribe for that number of ordinary shares.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (Jan. 14th.)	Closing Quotation. (Jan. 21st.)	Business done during week ending (Jan. 21st, 1892.) Highest.	Lowest.
250,000£	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	98 —101	99 — 102	...	...
1,300,980£	Anglo-American Telegraph, Limited	Stock	50½— 51½	51 — 52	51	50½
2,849,510£	Do. do. 6 p. c. Preferred	Stock	89 — 90	89½— 90½	90	89
2,849,510£	* Do. do. Deferred	Stock	13½— 13⅝	13½— 13⅝	13 11/16	13½
130,000£	Brazilian Submarine Telegraph, Limited	10	10½— 11	10½— 10⅝	10⅝	10⅜
53,200£	Do. do. 5 p. c. Bonds	100	102 —105	102 —105	...	...
75,000£	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	103 —107	103 —107	...	...
77,978£	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3⅛— 3⅜	3⅛— 3⅜	3⅜	3 3/16
69,996£	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛— 2⅜	2⅛— 2⅜	3	2 3/16
40,000£	Chili Telephone, Limited, Nos. 1 to 40,000	5	3½— 4½	3½— 4½	...	...
50,000£	City and South London Railway, Nos. 1 to 50,000	10	2½— 3½	2½— 3½	...	...
30,152£	City of London Elec. Lighting Co., Ltd., Ord. 40,001-70,152, £4 paid	10	6 — 6½	6 — 6½	6 7/16	6¼
$7,716,000	Commercial Cable, Capital Stock	$100	153 —157	153 —157	155¾	...
224,850£	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	⅜— ½	⅜— ½	...	...
20,000£	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	5½— 6	5½— 6	5⅞	5¾
16,000£	Cuba Telegraph, Limited	10	10 — 11	10 — 11	...	...
6,000£	Do. do. 10 p. c. Preference	10	16½— 17½	16½— 17½	17	...
12,931£	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3¼— 3⅜	3¼— 3⅜	...	...
6,000	Do. do. 10 p. c. Preference	5	9½— 10½	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	10⅞— 11⅛xd	10⅞— 11⅛xd	11⅛	10⅞
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14 — 14½xd	14⅛— 14⅜xd	14⅜	14 1/16
70,000	Do. 6 p. c. Preference	10	15 — 15½xd	15 — 15½xd	15⅜	15
200,000£	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	108 —111	108 —111	110	...
1,200,000£	Do. 4 p. c. Mortgage Debenture Stock	Stock	106 —109	106 — 109	108¼	108
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15 — 15½xd	15 — 15½xd	15¼	15
78,300£	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	102 —105	102 —105	...	...
276,200£	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	102 —105	102 —105	103	102¾
320,000£	Do. 4 p. c. Debenture Stock	Stock	107 —110	107 —110	...	...
135,000£	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	101 —104	101 —104	...	...
180,400£	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	101 —104	101 —104	103½	102
201,600£	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	99 —102	99 —102	101	100¾
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	6 — 6½	6 — 6½	6½	6 5/16
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
66,750	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	2¼— 2⅜	2⅜— 2⅝	2⅜	2½
70,000	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	3¾— 4	3⅜— 3⅞	...	...
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd	2	2⅛— 2⅜	2⅛— 2⅜	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅞— 10	9⅞— 10⅛	10⅛	10
180,042	Do. do. 6 p. c. Preference	10	14¾— 15	14⅞— 15	15	14¾
150,000	Great Northern Tel. Company of Copenhagen	10	19 — 19½	19 — 19½	...	...
220,000£	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	105 —108	...	...
12,134£	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	8 — 8½	8 — 8½	...	...
9,600£	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	9½— 10½	9½— 10½	...	...
41,600	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	20½— 21½	20½— 21½	21⅛	20¾
200,000£	Do. do. 4½ p. c., Deb., 1896	100	103 —105	103 —105	...	...
17,000	Indo-European Telegraph, Limited	25	41 — 43	41 — 43	42⅝	42⅜
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	4 — 5	3½— 4½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	8¾— 9½	8 — 9	...	...
30,000	†Liverpool Electric Supply, £3 paid	5	2⅜— 2⅝	2⅝— 2⅞	2¾	2⅝
10,000	Do. do. fully paid	5	4½— 5⅛	4⅜— 5	4⅝	...
38,348	London Platino-Brasilian Telegraph, Limited	10	6 — 7	6 — 7	...	...
100,000£	Do. do. do. 6 p. c. Debentures	100	106 —109	106 —109	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	9½— 10	9½— 10	10	9⅞
447,234£	National Telephone, Limited, Nos. 1. to 438,984	5	4½— 4⅝	4⅛— 4⅜	4⅜	4⅛
15,000	Do. 6 p. c. Cum., 1st Preference	10	12¼— 12⅜	12½— 13	12¾	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	12 — 12½	12 — 12½	...	...
420,000£	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	105 —108	104 —107	106⅝	105¼
250,000£	Do. (issued at 5 p.m., all paid)	...	54 — 57	54 — 57	...	...
6,318£	Notting Hill Electric Lighting Company, Limited, £8 paid ...	10	5½— 6½	5½— 6½	...	...
220,000£	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	5/16 — 7/16	5/16 — 7/16	...	...
9,000£	Reuter's Limited	8	7⅞— 8¼	7⅞— 8¼	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	8¼— 9	8½— 9	9	8 11/16
7,900	Do. do. do. 7 per cent. pref.	5	7 — 7½	7 — 7½	7⅜	7
3,381	Submarine Cables Trust	Cert.	116 —121	116 —121	116	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	4 — 4½	3⅞— 4¼	3 15/16	3¾
37,350	Telegraph Construction and Maintenance, Limited	12	42 — 44	42 — 44	43½	42½
150,000£	Do. do. do. 5 p. c. Bonds, red. 1894	100	100 —103	100 —103	...	...
58,000	United River Plate Telephone, Limited	5	1 — 2	1 — 2	...	...
146,370£	Do. do. 5 p. c. Debenture Stock ...	Stock	80 — 90	80 — 90	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	7 — 8	7 — 8	...	...
271,400£	* Do. do. do. 5 p. c. Debentures	100	100 —103	100 —103	...	...
30,000	West Coast of America Telegraph, Limited	10	4 — 5	4 — 5	...	...
150,000£	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	100— 104	99 —103	101	100
67,007£	Western and Brazilian Telegraph, Limited	15	10 — 10½	10 — 10½	10¼	10 1/16
30,364£	Do. do. do. 5 p. c. Cum. Preferred	7½	6¼— 6⅜	6¼— 6⅜	...	...
30,364£	Do. do. do. 5 p. c. Deferred	7½	3¾— 4¼	3¾ — 4¼	4	...
189,700£	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	104 —107	104 —107	...	...
237,200£	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph, Limited	10	1⅝— 1⅞	1⅝— 1⅞	...	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	9 — 9½	9¼— 9⅜	9½	...
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	7½— 8½	7½— 8½	8½	...
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	118 —122	118 —122	...	...
173,100£	Do. do. 6 p. c. Sterling Bonds	100	98 —102	98 —102	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	6½— 7	6½— 7	6 13/16	...

* Subject to Founders' Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7¼—7⅜.—European Sims-Edison Torpedo Company, shares £20, (fully paid), 20—20½.—Halifax and Bermuda Cable, 4½ per cent. bonds 85—95.—House to House Company (£5 paid) 4½—5.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares, £5 (fully paid), £5⅜—£6, 1st Preference Cumulative 6 per cent., £5 (fully paid), £5½—£6.—London Electric Supply Corporation, Ordinary (£5 paid), 1¼—1⅜. Do. 6 per cent. Preference 1⅞—2¼.—Manchester, Edison and Swan Company, £9 (£1 paid), ½—⅝.—National Telephone Debentures, 2½—3 prem.—Woodhouse and Rawson Ordinary of £5 (£2 10s. paid), 1⅜—1⅝.—£5 Preference, (fully paid) 3½— 3¾.—Ward's Electric Car (£10 paid), 1⅜—1⅝.

† Quotations on Liverpool Stock Exchange.

BANK RATE OF DISCOUNT.—3 per cent. (January 21st, 1892).

MAGNETIC LEAKAGE IN DYNAMOS AND MOTORS.* †

BY ARTHUR STANLEY IVES.

IT is a well-known fact that all of the lines of force generated in the field magnets, in almost if not quite all machines of the present day (and still more is it true of those of the past), do not accomplish the purpose for which they are produced, namely, pass through the core of the armature. This is partly due to the fact that the magnetising coils are not evenly distributed all around the magnetic circuit; but is mainly, of course, because in all cases and of necessity there must be at least two gaps in the magnetic circuit—between the armature and the faces of the pole pieces—in order to give clearance for rotation. To illustrate, if a soft iron ring be wound with insulated copper wire, the latter being put in circuit with a battery, a magnetic current will be produced which will give no external evidence of its existence. There are no poles, and no lines of force can be seen when iron filings are sprinkled on a cardboard above it; yet inside the mass of the ring there is a strong magnetic field, for a secondary wire will have an electromotive force generated in it if the primary circuit be made or broken, the same as if a straight magnetic bar of iron had been inserted or withdrawn mechanically. If, however, the iron ring be cut in any place, poles and lines of force immediately appear externally, and the iron filings when sprinkled on the cardboard form themselves about, as shown in fig. 1.

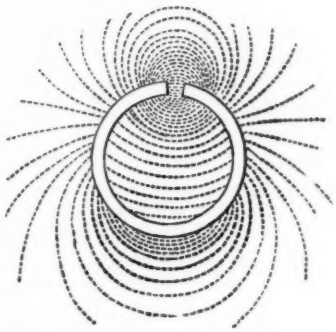


FIG. 1.—FIELD OF FORCE ABOUT A DISCONTINUOUS IRON RING.

We see, therefore, that even one air gap in a magnetic circuit will cause considerable leakage of magnetism into the surrounding medium.

In the case of dynamo field magnets the magnetism so escaping implies a waste of current energy required to produce it, and its value is generally quite appreciable in reducing the efficiency of the machine.

It is on this account, perhaps, as much as any other, that so much attention has of late been given to the form of the magnetic circuit, although very few direct investigations have been made regarding the distribution of the magnetism in dynamos and motors since those of Dr. Hopkinson in 1886, which is somewhat remarkable considering the value they would be to designers of these machines.

Of course measurements of magnetism (in electro-magnets at least) are most conveniently made, both absolutely and relatively, by means of secondary induction currents, produced by making or breaking the primary field circuit. Hence the problem becomes one of a measurement of "instantaneous," or more properly, "transient" currents, or electromotive forces, and nothing more. These induced currents are not really instantaneous on account of the self-induction of the field magnet coils, which prevents the field current from attaining its full value at once, and also in large machines the magnetism itself seems to be sluggish in following the magnetising current. Further, it takes an appreciable time for the induced current in the "test coil" to die away. For example, in testing the 400-light Edison machine it was noted that the induction lasted eight or ten seconds after making the field circuit.

It would seem therefore that a ballistic galvanometer, or one which would integrate over the whole time during which the induced current lasts, would be required for any accurate determinations, and such a one was, as a matter of fact, used by Dr. Hopkinson in his experiments. It is not, however, always easy to obtain a galvanometer which is sufficiently ballistic, nor when obtained to find a suitable place to mount it which shall be convenient to the machine to be tested, and, therefore, any other instrument which is at the same time accurate and portable is to be preferred.

The use of a Weston voltmeter (as the most accurate and portable instrument for the measurement of *ordinary* electromotive forces) suggested itself, and a number of preliminary tests were made to ascertain whether such a use would give the desired results. These tests were of a conclusive nature, and were highly satisfactory in every respect.

It might be considered, at first thought, that the "dead-beat" character of the instrument, as directly opposed to the accepted "ballistic" method, would be incompatible with the production of proportional deflections by means of currents of the nature considered. I hope at some future time to show, mathematically, that such a result is, however, in perfect accord with theory. For the present it is sufficient to say that for the same machine and the same magnetisation, it will be readily seen that the same retarding elements exist—having the same value and acting in the same way and during the same time—and, therefore, at any given instant the value of the current in the test coil will be exactly proportionate to the total number of lines of force which will pass through it, and the curves of induced current and time will be as shown in fig. 2. Hence,

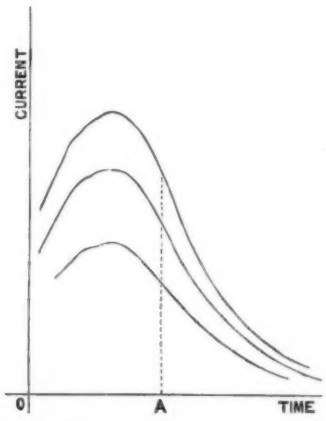


FIG. 2.—CURVES OF INDUCED CURRENT AND TIME.

whether we use an instrument which will integrate the whole induction, or one which will integrate only a part of it (up to the time, O A, for example), or one which gives simply the instantaneous value of the current at each instant, the amounts neglected will be proportional; and therefore the deflections will also be proportional to the total induction in each case, at least, when the deflections are small. In the Weston meters, however, the proportionality holds true for any value of the angle deflected—as can be readily shown from the theory of the instrument—a decided advantage over the ballistic galvanometer, whose deflections are only directly proportional if they are small.

The practical confirmation (referred to above) of this theory, namely, that the deflections of the voltmeter are directly proportional to the number of lines of force created or destroyed, multiplied by the number of turns of wire in the test coil surrounding them, was obtained by winding in succession a different number of turns of wire around the same part of one of the field magnets of a 3 H.P. Crocker-Wheeler motor, and the deflections of the voltmeter noted on "breaking" the field circuit. The armature had been disconnected, and the poles of the field connected directly with a constant potential circuit of about 120 volts. The ends of the test coil were attached directly to the voltmeter. The results were as follows:—

* Graduation thesis in the Electrical Engineering course at Columbia College, 1891.

† New York *Electrical World*.

TABLE I.

Number of turns	Mean deflection (of 5 observations).	Deflection (per turn).
3	50·3	16·77
6	99·9	16·65
9	149·2	16·58
12	198·2	16·52
15	247·4	16·49
18	296·7	16·48
21	346·6	16·51
24	395·5	16·48

Mean = 16·56; or mean, omitting first two observations, = 16·51.
The scale on which these readings were taken could not be read directly to less than four units, so each unit equals a quarter of one division. Single observations were read to half units or eighth divisions.

The variation of the smaller deflections from the rest is no doubt due simply to the fact that they are small, the same error in observing being a larger percentage of the reading than in the case of larger deflections.

It was also observed at another time, and with a different machine, that for low magnetisations (where the magnetism is proportional to the field current in direct ratio), the deflection produced in the voltmeter with the same number of turns in the secondary is exactly proportional to the current sent through the field, the results differing only about one-tenth of 1 per cent.

Hence we may safely assume that errors of observation are as great or greater than any instrumental discrepancies in proportionality; and, on this assumption, the method becomes a practical one, with the advantage of using an instrument which requires no adjustments, and which is not disturbed by ordinary magnetic changes in its neighbourhood.

The following machines have been tested (employing this method):—

I. ⅙ H.P. Crocker-Wheeler motor.
II. 3 H.P. Crocker-Wheeler motor.
III. 400-light (117 volts—200 ampères) standard (multipolar) dynamo.
IV. 100-light (1,000 volts—8 ampères) Fort Wayne alternator.
V. 400-light (117 volts—200 ampères) Edison dynamo.

In each machine a certain number of turns of wire were wound around the various parts named, except for determining the leakage directly, in which case the coils were held against the surface from which it was thought to take place. In every case (including the preliminary experiments) the deflections were observed on *breaking* the primary field circuit, because its maximum value was found to be about double that of the *make* induced current (as would have been expected from theory—see Fleming on the

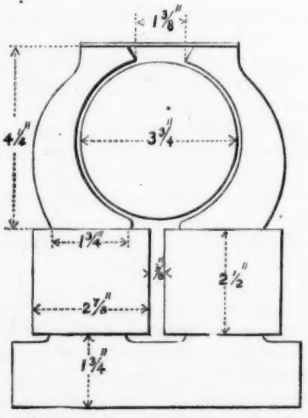


FIG. 3.—VERTICAL CROSS-SECTION OF CROCKER-WHEELER MOTOR.

"Alternate Current Transformer," Vol. I., p. 191), and its duration was not as long either. The instrument used was the calibrating coil (137·7 legal ohms resistance) of Weston voltmeter No. 290—600 volt scale, one division equals four volts—that being the most delicate instrument of the type available. No. 26 wire, double covered, B & S. gauge, was used throughout for the test coil.

The tests on all machines were made with their fields magnetised to their regular working strength; that is to say, the current sent through the field coils was that for which they were designed. The armatures, however, were carrying no current and were stationary.

I.—ONE-SIXTH H.P. CROCKER-WHEELER MOTOR.

A vertical cross section of this machine is given in fig. 3, with all important dimensions.

As these were the first measurements made they are probably less accurate (on that account) than those taken on the other machines:

TABLE II.

Position of coil.	Number of turns.	Mean deflection.	Deflection per turn.	Percentage of max.
Middle of field coil	10	15	1·50	100·
Base of pole piece	12	15	1·25	83·3
Middle of pole piece	13	8	·62	41·3
Armature	14	15	1·07	71·3
Leakage between points of poles (upper)	24	0·5	·02	1·3

In this machine therefore we have a total loss of 28·7 per cent., of which 16·7 per cent. leaks from the upper half of the field coil, and 12 per cent. from the surface of the pole piece.

We see also that due to leakage from the lower half of pole piece, a little less than one-half of the magnetism that enters its base passes through its middle section.

We require 140 per cent. of the effective magnetism to be generated by the field.

II.—3 H.P. CROCKER-WHEELER MOTOR.

Fig. 4 shows the general dimensions of this motor as well as the "lettered" positions of the test coil.

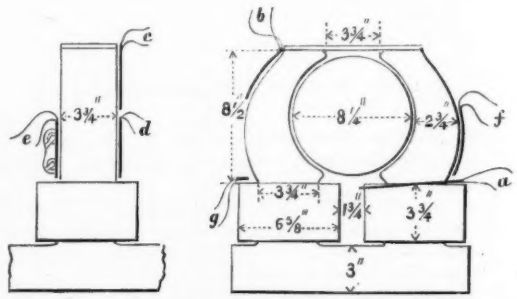


FIG. 4.—DIMENSIONS OF CROCKER-WHEELER ONE-SIXTH HORSE-POWER MOTOR.

The following measurements were taken on this machine:—

TABLE III.

Position of coil.	Number of turns.	Mean (of 10) deflections.	Deflection per turn.	Percentage of max.
Middle of field coil	15	246·50	16·433	100.
Yoke end „ „	15	244·65	16·310	99·2
Pole „ „ „	15	236·95	15·797	96·1
(*a*)	15	235·55	15·703	95·6
(*g*)	75	3·75	0·050	0·3
Base of pole piece	15	231·45	15·430	93·9
(*d*)	75	19·95	0·266	1·6
(*e*)	75	27·75	0·370	2·3
(*f*)	75	19·45	0·258	1·6
Middle of pole piece	30	227·35	7·578	46·2
(*b*)	75	16·05	0·214	1·3
(*c*) (each side)	75	15·80	0·201	1·2
Top of pole piece	75	33·45	0·446	2·7
Armature	18	244·45	13·581	82·6
Between upper horns of pole pieces	75	6·50	0·087	0·5

The following conclusions are apparent :—

1. The discrepancy in observations is very small.

Leakage from upper half of coil ...	=	4·2 per cent.
Leakage from pole piece :—		
Back	=	2·9
Sides	=	4·3
Top	=	3·2
Total leakage found directly ...	=	16·6 per cent.
Total loss (found by subtracting armature from maximum)	=	17·4
Unaccounted for	=	0·8 per cent.

2. There is practically no leakage from the lower half of coil (only 0·8 per cent.) ; and only 4 or 5 per cent. from the base of the machine which acts as the yoke (not in Table III., but actually obtained. It was found, also, by winding 50 turns around shaft and bearings nearest armature, that the leakage in that direction is only about $\frac{1}{10}$th per cent.).

3. As in the $\frac{1}{6}$ H.P. motor, and for the same reason, we have slightly less than one-half the magnetism entering the base of the pole piece passing through its middle section.

4. We require 121 per cent. of the effective magnetism to be generated by the field.

III.—400-LIGHT STANDARD DYNAMO.

A single pole with its adjacent coils is shown in fig. 5.

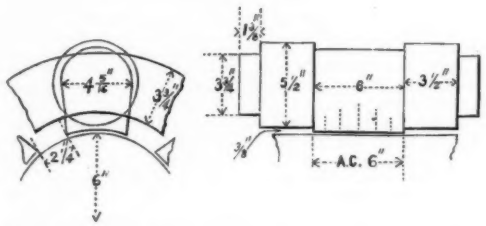


FIG. 5.—SINGLE POLE AND ADJACENT COILS OF STANDARD DYNAMO.

The measurements taken on this machine were as follows :—

TABLE IV.

Position of coil.	Number of turns.	Mean (of 10) deflections.	Deflection per turn.	Percentage of maximum.
Middle of field coil ...	15	233·5	15·567	100·
Yoke end	15	233·0	15·553	99·8
Yoke	18	245·7	13·650	87·7
Pole end of field coil...	15	217·2	14·480	93·6
Armature	20	236·0	11·800	75·8
Back of pole piece ...	75	52·3	0·697	4·5
Each side	75	73·8	0·984	6·3
Leakage found from inside half of coil	75	70·3	0·937	6·0

Conclusions :

1. Leakage from half coil			6·0
„ „ pole piece :			
Back	=	4·5	
Sides	=	12·6	17·1
Total leakage found directly	=		23·1 per cent.
Loss (by subtraction) from half coil	=	7·0	
„ „ „ pole piece	=	17·2	
Total loss (subtracting armature from maximum)	=		24·2
Unaccounted for	=		1.1 per cent.

2. Only 87·7 per cent. of the magnetism passes through the yoke, though practically no leakage takes place from the half coil.

3. The leakage from the half coil nearer the pole piece is distributed about as in fig. 6.

4. We require 132 per cent. of the effective magnetism to be generated by the field.

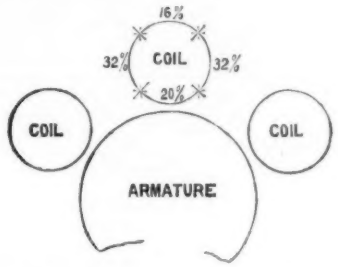


FIG. 6.—DISTRIBUTION ABOUT THE POLE PIECE IN THE STANDARD DYNAMO.

(To be continued.)

PRODUCTION OF CAUSTIC SODA BY AN ELECTROLYTIC METHOD.

FROM an electro-chemical point of view, if the term is admissible, there seems little doubt as to the success of the new electrolytic process for the direct production of caustic soda and chlorine, which was shown in operation on a recent occasion at Phœnix Wharf, Church Road, Battersea, S.W. From a commercial point of view, however, it is at present doubtful whether the process, which is the invention of Mr. James Greenwood, electro-chemist, will be the means of "a coming revolution in the chemical trade." The latter words, it may perhaps be unnecessary to state, are quoted from the circular issued by the Caustic Soda and Chlorine Syndicate, Limited, promoted by the Commercial Contract Corporation, Limited, of 58, Lombard Street, E.C.

As our readers are already aware, it has long been well known that caustic soda and chlorine can be produced from a solution of common salt by means of electricity, and although scientists have been experimenting for many years in endeavouring to develop this method of production, they have hitherto failed to successfully demonstrate it on a sound commercial basis. Mr. Greenwood claims, however, to have solved this important problem, but this yet remains to be *proved*. One of the features in connection with this new departure is the method by which the electrolysed products are separated, and their re-combination rendered impossible. Numerous attempts have been made to attain this object, but no satisfactory method is stated to have ever been invented prior to the introduction of the patent diaphragm used in this process. This diaphragm consists of strips of slate arranged in a frame, V fashion, one above the other, and packed with asbestos fibre. This, then, is said to prevent the re-combination of the electrolysed products, but experiments are being made with glass as a more durable substitute for the slate.

Another special feature of the process is the use of a compound anode formed of carbon plates or blocks with a metal core to increase the conductivity. The anode is treated so as to render it non-porous and unattackable by the nascent chlorine evolved on its surface. No anode, the company claims, has ever been invented that is at all suitable for working on a large scale, and the introduction of this compound anode constitutes, it is said, a marked advance in the apparatus used in electrolytic methods of production.

The installation shown in operation consists of five large electrolytic vessels, each of which is fitted up with five anodes and six iron cathodes arranged alternately. The anodes and cathodes are separated by the diaphragms already referred to, and each vessel is thus divided into ten anode or chlorine sections, and ten cathode or caustic soda sections. The anodes and cathodes in each vessel are connected up in parallel similar to an ordinary storage battery, but the five electrolytic vessels are connected up in series. The electromotive force required to overcome the resistance of each vessel is about 4·4 volts, with a current density of 10 ampères per square foot of electrode surface.

The 50-anode sections are connected by means of vulcanite or glass-lined iron tubes, the inlet being at the bottom, and the outlet at the top of each section. The whole of the cathode sections are connected in the same manner. In commencing to work, the electrolytic vessels are charged with a solution of common salt—about 13 per cent. of salt and 87 per cent. of water—through which a current of electricity is then passed, thus decomposing or splitting up the salt into its elements, chlorine and sodium. In the separation of the sodium, however, a secondary action takes place, which converts it into caustic soda. The charging tanks containing the brine are placed on an elevation, whilst the electrolytic vessels are arranged step fashion, that is one above the other. By this means the solutions are automatically circulated. The solutions are, moreover, pumped back from the lowest vessel to their respective charging tanks, the salt solution to be further decomposed, and the caustic soda solution to be further concentrated. This is effected by two pumps. The chlorine gas evolved during the process in the 50-anode sections ascends into and is conveyed by means of branch and main tubes into four absorbers. The latter contain milk of lime (or water and lime) which is kept in a state of agitation, and which takes up the chlorine gas and transforms it into bleaching or

chlorate liquor, as may be required. If the chlorine is wanted to be made into bleaching powder, it is then conveyed into leaden chambers and treated with lime in the usual manner. This was, however, not demonstrated.

The caustic soda formed in the 50-cathode sections is rendered more or less concentrated as required. If needed in solid form and practically free from salt, the caustic alkaline liquor is transferred to evaporating pans, where it is concentrated to the required strength by evaporation, and at the same time the salt remaining in the solution is eliminated by precipitation. This again was not shown by the installation in operation, which was characterised by the inventor not as an experimental plant, but one for the purpose of "demonstration." Wherein, we would ask, lies the difference?

The E.M.F. used for the five vessels was 21·5 volts and the current 200 ampères, an Elwell-Parker continuous current machine being used.

We now come to the reports drawn up on the process. Mr. W. H. Preece, reporting on the system, says:—

"A mean current of 240·26 ampères, at a mean pressure of 4·368 volts for six hours, or 6,301 watt hours, were expended upon 32 gallons of brine, containing 16 per cent. of sodium chloride. During this time 5·2 lbs. of the salt were broken up, or 1,209·4 watt hours were expended in separating 1 lb. of sodium chloride into its constituent elements. The *theoretical* energy required to perform the same operation is 907 watt hours. Hence the commercial efficiency of the process is 75 per cent., but I am quite certain that in actual practice and with further experience even better results can be obtained. I calculate the cost of producing electrical energy in the coal districts with triple expansion modern engines and dynamos, working continually at full load, to be ¼d. per kilowatt hour. This figure is confirmed by actual experience, and is not merely estimate alone. The cost of breaking up one ton of salt will therefore be £3 7s. 8d. With water-power it can be reduced one-half. These figures show that the total cost of production of caustic soda and bleaching powder and liquor will be little more than one-third of their present market value."

When the inventor was questioned as to how a Board of Trade unit under such conditions could be obtained for ¼d., he was unable to answer, and merely referred to Mr. Preece's report.

Messrs. Cross and Bevan report that the efficiency of the process as compared with their preliminary examination "has risen to 80 per cent. as against 70 per cent., and at the same time the expenditure of power necessary to obtain this result is satisfactorily low," whatever that may mean. Dr. Gore, F.R.S., is, however, more guarded in his statements.

Sufficient has been said to show that the statements put forth on behalf of the process are painted in a rather roseate hue. If the company can produce caustic soda and chlorine on a commercial scale at an economy of 50 per cent. as compared with present methods as they claim to be able, so much the better for the paper, soap, and bleaching industries; but the publication of anything but well-ascertained facts is certainly not calculated to increase the confidence of intending shareholders of the company which it is intended to promote. The process is not yet demonstrated "on a sound commercial basis," neither will the syndicate give figures concerning the output of the present plant. A large order, as in the case of the Elmore companies, is in prospect, but this is only another vagary of the method adopted in bringing "a coming revolution in the chemical trade" before the notice of the public.

PROCEEDINGS OF SOCIETIES.

Physical Society, December 4th, 1891.

Prof. W. E. AYRTON, F.R.S., President, in the chair.

Messrs. P. L. Gray, A. Anderson, H. Davey, L. W. Fulcher, H. H. Hoffert and W. Watson were elected members.

A paper on A PERMANENT MAGNETIC FIELD, was read by Mr. W. HIBBERT, A.I.E.E., F.I.C. The author had noticed the approximate constancy of an "aged" bar magnet, and he obtained still greater constancy by attaching pole pieces to a bar magnet, of such a shape as to give a nearly closed circuit of small "magnetic resistance." The pattern now described consists of a steel rod 1 inch diameter and about 2½ inches long, with a cast iron disc 4 inches diameter and ⅝th inch thick fixed at one end; the other end is fitted in a hemispherical iron shell which surrounds the bar and comes flush with the upper surface of the disc. An annular air space, less than $\frac{1}{16}$th inch wide, is left between the cylindrical surface of the disc and the inside of the shell, and when the bar is magnetised, a strong magnetic field exists in this space. To use this field for producing electro-magnetic impulses, a coil of wire is wound in a shallow groove on a brass tube which can slide axially through the annular space, thus cutting all the lines. The tube is allowed to fall by its own weight, a neat trigger-arrangement being provided for effecting its release. The instrument exhibited had 90 turns of wire in the coil, and the total magnetic flux across the air space was about 30,000 C.G.S. lines. A large electro-magnetic impulse is therefore obtainable even through resistances as great as 10,000 ohms. Tests of three instruments show that there has been practically no magnetic decay in seven months. The author therefore considers them satisfactory, and is prepared to supply them as magnetic standards. To facilitate calculation the number of lines will be adjusted to a convenient number, say 20,000 or 25,000. Several uses to which the instruments are well suited are mentioned in the paper, and a simple way of determining permeability by the magnetometer method, is described.

Mr. BLAKESLEY thought the name given to the instrument was inappropriate, for it really gave a constant impulsive E.M.F.

Dr. SUMPNER said the constancy of the sensibility of D'Arsonval galvanometers was a measure of the constancy of magnets having nearly closed circuits. Such instruments in use at the Central Institution had remained unchanged for several years.

Prof. S. P. THOMPSON admired Mr. Hibbert's instrument and thought it would be very useful in laboratories. Standard cells, he said, were not always reliable, and condensers were the most unsatisfactory of electrical standards. On the subject of permanency of magnets, he said that Stronhal and Barus found that magnets with nearly closed circuits were most constant, and that, to give the best results, the hardness of the steel should be less the more closed the circuit. Mr. Hookham had also found that by using a nearly closed circuit and reducing the strong magetisation by about 10 per cent., great constancy could be obtained. Some years ago, he (Dr. Thompson) had tried the effect of ill-treatment on magnets, and observed that touching or hitting a magnet with non-magnetic material had little effect, whilst similar treatment with iron or magnets affected them considerably. Suddenly removing the keeper of a magnet tended to increase the magnetism, whilst putting a keeper on suddenly, had the reverse effect. Stronhal and Barus had also investigated the temperature coefficient of magnets, and found that this might be reduced by subjecting the magnet to rapid changes of temperature after the first magnetisation, and then remagnetising.

Mr. W. WATSON inquired what was the percentage fall in strength of Mr. Hibbert's magnets. The bars used in magnetic surveys had been tested frequently, and they lost about 0·5 per cent. in six months.

The PRESIDENT asked what was the temperature coefficients of the magnets described in the paper? Mr. Evershed, he said, thought it was between 0·01 per cent. and 0·05 per cent. for ordinary magnets. He thought the instrument shown by Mr. Hibbert would be of immense value if the magnet was really permanent. By it ballistic galvanometers could be readily calibrated, and, when combined with a resistance box, it could also be used as a standard for current; for since the constant of a ballistic galvanometer for quantity can be determined from its constant for current, if the periodic time be known, conversely that for current can be found from the constant for quantity. In some instances this would be of great use. Speaking of the temperature coefficient of condensers, he said that in some cases the specific inductive capacity of dielectrics diminished with rise of temperature whilst in others it increased.

Mr. HIBBERT in reply, said he found the temperature coefficient of his magnets to be roughly about 0·03 per cent., but he had not investigated the matter very carefully. In making his measurements, no correction had been made for the variation of capacity of his condenser with temperature.

Mr. Walter Baily, M.A., took the chair, and the PRESIDENT communicated a NOTE ON ROTATORY CURRENTS. The subject, he said, was probably familiar to most persons present, for it had been frequently referred to in the scientific papers. Alternate currents could be obtained from an ordinary direct current dynamo by making contact with two points in the armature, say by connecting these points to insulated rings on the shafts, and using extra brushes. A direct current motor, similarly treated, transforms direct currents into alternating currents, or into mechanical power. If two pairs of points in the armature be selected, situated at opposite ends of two perpendicular diameters, then two alternating currents, differing in phase by 90°, can be obtained; and by choosing suitable points in the armature, two, three or more currents differing in phase by any desired angles can be produced. In ordinary motors the connections for doing this would be troublesome, but the Ayrton and Perry form, which has a stationary armature, lends itself readily to this purpose, for contact can be made with any part of the armature with great facility. A motor of this kind was exhibited, in which contact was made with four equidistant points on the armature. On connecting opposite points through fine platinum wires, and running the motor slowly, the wires glowed alternately, one being bright whilst the other was dark, and *vice versa*, thus demonstrating the existence of two currents in quadrature. When the four points on the armature were joined to the four corners of a square of platinum wire, the wires became incandescent in succession, the glow appearing to travel round the square, and suggesting the idea of rotatory currents. A Tesla alternating current motor was also driven by two currents, differing in phase by 90°, obtained from the armature of the Ayrton and Perry direct current motor above mentioned.

The ease with which currents differing in phase by any amount can be obtained from such a motor, led the author to investigate theoretically the case of two circuits connecting opposits ends of two diameters inclined at any angle α. Calling the currents in these circuits at any instant, A_1 and ρ, he had found that

$$A_1 = 2\,n\,E_0 \frac{\sqrt{\left(r_2+\rho\frac{\pi}{2}\right)^2+\rho^2\left(\frac{\pi}{2}-\alpha\right)^2-2\left(r_2+\rho\frac{\pi}{2}\right)\rho\left(\frac{\pi}{2}\alpha\right)\cos\alpha}}{\left(r_1+\rho\frac{\pi}{2}\right)\left(r_2+\rho\frac{\pi}{2}\right)-\rho^2\left(\frac{\pi}{2}-\alpha\right)^2} \times \sin(pt+\phi)$$

where n = number of turns on armature per radian, E_0 = maximum E.M.F. per convolution.

" ρ = resistance of armature per radian, p = angular velocity of rotation.

" r_1 = resistance of external circuit in which current A_1 passes.

" r_2 = resistance of external circuit in which current A_2 passes.

and

$$\tan\phi = \frac{\rho\left(\frac{\pi}{2} - \alpha\right)\sin\alpha}{r_2 + \rho\frac{\pi}{2} - \rho\left(\frac{\pi}{2} - \alpha\right)\cos\alpha}$$

A similar expression, in which r_1 is written for r_2, and r_2 for r_1, gives the value of A_2.

The phase angle between the currents is given by

$$\tan(\phi + \psi) = \frac{\left(r_1 + \rho\frac{\pi}{2}\right)\left(r_2 + \rho\frac{\pi}{2}\right) - \rho^2\left(\frac{\pi}{2} - \alpha\right)^2}{\left(r_1 + \rho\frac{\pi}{2}\right)\left(r_2 + \rho\frac{\pi}{2}\right) + \rho^2\left(\frac{\pi}{2} - \alpha\right)^2 - \rho\frac{\left(\frac{\pi}{2} - \alpha\right)\left(r_1 + \rho\frac{\pi}{2}\right)}{\cos\alpha}}$$

$$= \tan\alpha.$$

The expression for ϕ shows that the phase of the current in circuit A_1 is independent of the resistance r_1. On the other hand, varying r_2 alters ψ.

It was also pointed out than tan $(\phi + \psi)$ is generally greater than tan α.

DECEMBER 18TH, 1891.

Prof. W. E. AYRTON, F.R.S., President, in the chair.

Mr. R. W. Mond, F.R.S.E., was elected a member of the society.

The PRESIDENT announced that it had been found necessary to alter the dates of the meetings to be held after Christmas from those already published to the following:—January 22nd, February 12th and 26th, March 11th and 25th, April 8th, May 13th and 27th, June 10th and 24th.

A "NOTE ON INTERFERENCE WITH ALTERNATING CURRENTS" was communicated by Mr. M. H. KILGOUR. Whilst studying Dr. Fleming's paper on "Some Effects of Alternate Current Flow in circuits having Capacity and Self-induction," the author constructed some additional curves. He was thereby led to investigate whether the serious rises of pressure produced by adding capacity would occur over considerable ranges of capacity, or whether they would only take place when the capacity was nearly equal to a particular value. Taking the case of a condenser of C farads, in series with a circuit of resistance R ohms, and inductance L henrys, he showed that the maximum value of λ (the ratio of the pressure across the condenser terminals to that across the condenser and inductive resistance) is obtained when $C = \frac{L}{R^2 + p^2L^2}$ (1) where $p = 2\pi$ times the frequency. The maximum of λ produced by this capacity being given by the expression $\Lambda = \frac{\sqrt{R^2 + p^2L^2}}{R}$ (2). Taking $R = 10$ and $p = 2\pi \cdot 1000$ curves plotted from equations (1) and (2) between C and L, and between Λ and L had been drawn. The C L curve rises to a very sharp peak at L = ·0015 and falls rapidly. That between Λ and L starts horizontal and bends upwards, and approximates to an inclined straight line for values of L greater than 0·002; when L = 0·1, Λ = 63.

Considering the question of the range of capacity with which a given rise of pressure can occur, it was pointed out that when the values of L, R, and p, are such as to make a large rise possible, a rise exceeding a moderate value can only be obtained for values of C, differing little from that given by equation (1). On the other hand, when the circuit is such that the maximum rise possible is not large, then a rise exceeding a given moderate value can be obtained over a much wider range of capacity. Hence the author concludes that the larger the possible rise the smaller is the probability of a serious rise occurring.

The effect of shunting the condenser by a circuit of resistance, r, and inductance, l, is next dealt with in the paper, and the values of C, which make λ a maximum determined, as well as the maximum value λ can have.

Subsequently, the author examines whether the practical case of an alternator feeding a transformer through a concentric cable may be simplified without introducing serious error, by assuming the capacity concentrated at either end of the cable, and concludes that in ordinary cases little error will be thus made. In an experiment made with a 100-kilowatt alternator, ¾ mile of 37/15 concentric cable, and 18-kilowatt transformer, a rise of ¼ per cent. was found to occur at the terminals of the alternator when the cable was connected. Putting on the transformer unloaded or loaded produced little change in the rise of pressure, this in all cases being between 0·2 and 0·3 per cent.

Dr. SUMPNER asked whether the conditions as to the range of capacity with which a given rise of pressure was possible was true for small rises such as occur in practice. Cases where the maximum possible rise was of the order 63, were not likely to occur at ordinary frequencies. The highest rise he had ever known was 11. He thought the time-constant of the inductive coil chosen, viz., $\frac{1}{100}$th of a second, was very large. In circuits containing iron it was practically impossible to get such large time constants, for the power spent in the iron increased the effective resistance. Referring to the narrow range of capacity within which large rises were possible, he pointed out that such cases were found in Hertz's resonators, where the rises were immense, but to obtain them the adjustments had to be very accurately made.

Dr. S. P. THOMPSON said he regretted that Prof. Fleming was not present, for he had recently investigated Hertz's experiments, and had obtained curves very similar to that got for the Deptford mains. The curve between Λ and L was very interesting. It was in fact a curve between the secant of the angle of lag and L, as could be seen from formula (2). In practice, one would be working on the lower portion, and hence the rises would be small.

Mr. KILGOUR explained that in the paper his first object was to show that the product of the range of capacity between which a rise greater than a given value would occur, and the maximum possible rise was approximately constant for different circuits. Secondly, he wished to prove that the capacity of concentric cables could be assumed, to be localised at either end without introducing much error in the rises of pressure calculated therefrom.

Dr. THOMPSON, speaking of nomenclature, regretted that the word inductance should be used sometimes for L and at other times for L p, and thought its meaning should be restricted to the latter.

Prof. PERRY said a name was needed for coefficient of self-induction. Resistance was practically independent of frequency, and "inductance" should have no reference to frequency.

Dr. SUMPNER thought it important to have a name for L p, for that quantity comes into calculations most frequently. He would have preferred that "inductance" should mean L p, but Mr. O. Heaviside, who introduced the term, had used it for L.

The PRESIDENT remarked that some time ago Dr. Sumpner and himself felt the need of a name for L p, and thought of using "inductance," but on referring to Mr. Heaviside's articles, found it used for L.

Dr. C. V. BURTON asked whether the word "self-induction" could not be used as an abbreviation for "coefficient of self-induction?"

Dr. THOMPSON pointed out that this word already had a meaning, viz., L multiplied by current.

Dr. BURTON then suggested that inductivity might be applicable.

Dr. THOMPSON said the word "impedance" was also used ambiguously, for the sense in which Dr. Lodge uses it in his "Modern Views of Electricity" is not the same as the vector sum of R and L p.

Prof. PERRY recalled the fact that "impedance" had been defined by the Committee of the British Association as the ratio $\frac{\text{effective voltage}}{\text{effective current}}$.

Dr. THOMPSON said this definition was only applicable to periodic currents, and not to intermittent or transient ones.

The PRESIDENT said he understood the first object of Mr. Kilgour's paper was to enquire whether the dread of rise of voltage occurring when concentric mains were used, need exist. When Dr. Fleming's paper was read, the general idea was that concentric cables were dangerous. In the discussion on it, he, amongst others, had pointed out that the chance of a large rise of pressure was not a serious one. Mr. Kilgour had now shown that the range of capacity over which a particular rise could occur, is inversely proportional to the maximum rise possible in the particular circuit. When the circuit was such that a large rise was possible, the probability of any serious rise taking place was very small, hence the fears of large rises were more or less unfounded.

The second part of the paper was to show that ordinary problems on concentric cables could, in practice, be treated with sufficient accuracy by assuming the capacity localised at either end of the cable, instead of distributed along its length.

NEW PATENTS—1892.

97. "Improvements applicable to the production of electric light in walking sticks and other similar articles." S. H. LEVI. Dated January 2nd.

106. "Improvements in electric switches." W. H. STURGE. Dated January 4th. (*Complete.*)

109. "Improvements in telephone exchange systems." A. M. ROSEBRUGH. Dated January 4th.

110. "Improvements in generating and distributing electrical energy." R. KENNEDY. Dated January 4th.

111. "Improvements in distributing and converting alternating electric currents, and in apparatus therefor." R. KENNEDY. Dated January 4th.

152. "Improvements in vulcanising the insulating covering of electric conductors." G. G. M. HARDINGHAM. (Communicated by J. J. C. Smith, United States.) Dated January 4th.

177. "Improvements in electric drop lights." G. E. PAINTER. Dated January 5th. (*Complete.*)

207. "An electric regulator." E. J. HOUGHTON and W. WHITE. Dated January 5th.

253. "Improvements in magnetic apparatus." W. T. GOOLDEN and S. EVERSHED. Dated January 6th.

259. "A method of utilising electrical energy for the heating of water and other liquids." A. B. WOAKES. Dated January 6th.

278 "A wall contact and plug for electrical conductors." W. WHITE and E. P. ALLAM. Dated January 6th. (*Complete.*)

310. "Improvements in or relating to joints and attachments for concentric armoured electric conductors and the methods of making the same." J. D. F. ANDREWS. Dated January 6th.

334. "Improved form of a dry galvanic element." H. NEHMER. Dated January 7th.

355. "Improvements in or relating to the electro-deposition of tin upon metals." E. C. FURBY. Dated January 7th.

359. "An improvement in dynamo-electric machines." SIEMENS BROS. and Co., LIMITED, J. NEBEL, and W. A. COLLINGS. Dated January 7th.

360. "Appliance for equalising the loads of the several conductors of rotary phase current installations." SIEMENS BROS. and Co., LIMITED. (Communicated by Messrs. Siemens and Halske Germany.) Dated January 7th.

372. "Improvements in soldering, melting, and coating metals by the aid of electricity." N. BENARDOS. Dated January 7th.

406. "Improvements connected with electric motors and electric elevator apparatus." THE AMERICAN ELEVATOR COMPANY. (Communicated by Otis Bros. & Co., United States.) Dated January 8th. (*Complete.*)

407. "Improvements in liquid electrodes." E. S. D'ODIARDI. Dated January 8th.

408. "Improvements in electro-inhalers." E. S. D'ODIARDI. Dated January 8th.

409. "Improvements in the electric static sprays." E. S. D'ODIARDI. Dated January 8th.

410. "Improvements in pneumo-dynamometers." E. S. D'ODIARDI. Dated January 8th.

411. "Magneto-voltaic electrode." E. S. D'ODIARDI. Dated January 8th.

416. "An improved process for manufacturing galvano-types." H. CAPELLE. Dated January 8th. (*Complete.*) [Date applied for under Patents Act, 1883, Sec. 103, June 9th, 1891, being date of application in France.]

475. "Improvements in apparatus for testing insulation electric meters and alternating current motors." J. SWINBURNE. Dated January 9th.

486. "Improved variable resistances for electrical purposes." R. E. B. CROMPTON. Dated January 9th.

487. "Improvements in means or apparatus for producing decorative, advertising, or other effects by the aid of electricity." R. E. B. CROMPTON. Dated January 9th.

491. "Improvements in and relating to underground conduits for electric wires." C. A. W. HULTMAN. Dated January 9th.

495. "An improved electric battery electrolyte." G. H. ROBERTSON. Dated January 9th.

499. "A new or improved dynamoter or continuous current transformer, and method of winding the field magnets of such." F. M. NEWTON and T. HAWKINS. Dated January 9th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1890.

15,873. "Improvements in multiple switchboards." C. R. BONNE. (A communication from Mix and Genest Company, Limited, of Berlin.) Dated October 22nd. 8d. The jack consists of a shell in which the key is pushed in, also a contact spring and a second contact spring, both of which are attached to an ebonite plate. The contact spring is in contact with the shell when at rest, while the spring is isolated from the shell by means of an ebonite plate. The contact springs are provided with indents, respectively, which are placed relatively to one another in such a manner that an inserted key first pushes against the indent of one spring and then against the indent of the second spring. 1 claim.

16,110. "Improvements in the distribution of electricity." T. PARKER, J. H. WOODWARD, and E. S. G. REES. Dated October 10th. 8d. The motor generators at the sub-stations are supplied with high tension currents from the switch stations, and the circuits from the switch stations to the sub-stations, and the switches for controlling these circuits are so arranged that when not more than a certain fraction (depending upon circumstances) of the maximum current supplied from any sub-station is being used, the motor generator at that station is stopped, the lamps or motors then in use being then supplied from the switch station direct at a suitable electromotive force through the same leads as those used for supplying the high-tension current to the motor generators when more than the fraction of load determined is being used. 4 claims.

17,035. "Improvements in electricity meters." J. LEA. Dated October 25th. 8d. This invention consists in placing an automatic recorder to any of the present ammeters or voltmeters, or both, in such a manner that at intervals of time it shall register the amount of current in use and used. This is accomplished by placing behind the indicating needle a short light bar which has a pin, which presses against the indicator needle, or is by its movement allowed to follow it to the extent of its movement and carry a pawl or click arrangement which runs over a tooth wheel; this wheel is in gear with a counting train like that used in ordinary gas meters. At intervals of time this light bar is taken by a pin back to zero, and in doing so will move the click or pawl into the first tooth, and carry the wheel with it, thus turning the counter train on, according to the number of teeth the pawl had behind it, which was in accordance with the distance the indicator needle was from zero. 3 claims.

17,394. "Apparatus for effecting the make or break of an electric circuit at any suitable number of points." L. VIALET-CHABRAND. Dated October 30th. 11d. Has for object to provide apparatus and connections so as to form a complete system or electrical installation that will allow of the making or breaking an electric circuit for any desired purpose from any number of determined points. An example of one of the special cases for which the invention may be used is the lighting and extinguishing of an electric lamp from as many determined points as may be found useful. 7 claims.

17,711. "Improvements in means for the distribution of electricity." H. EDMUNDS. Dated November 4th. 11d. Two or more cables are led in proximity to the various points for local supply, these constituting the discharge circuit for sets of storage batteries, the wires to carry the current for local utilisation being connected to these cables at any places desired. A single cable may be led from the generator at the central or charging station, in proximity to the places where the storage batteries are placed. A switch is placed in connection with each set of storage batteries. The switches are moved so as to disconnect, say, every third group of each set of storage batteries from the discharge circuit and put them into the charging circuit. The charging current then passes through these batteries, and thereafter, at the proper time, the switches are moved, so as to put these batteries out of the charging circuit into the discharging circuit, and at the same time putting into the charging circuit another group of batteries to receive charge, and so on. 7 claims.

17,852. "Improvements in dynamo-electric or magneto-electric generators for signalling or medical purposes." H. BINKO. Dated November 6th. 6d. Consists in providing a magneto-generator with an arrangement externally similar to such as used in electric bell systems working with electric batteries, to which a straight or quadrant rack action, direct or indirectly, is fixed, which sets, by means of a suitable gearing, the electro-magnet or the permanent magnet in rotation at a high speed, thereby producing a continuous and powerful current in an easy, convenient, and efficient manner. 3 claims.

19,239. "Improvements in electric switches." H. BARTON. Dated November 26th. 8d. Relates more particularly to that class of switches, in which a spring is employed for placing a two-armed lever from its mid position into its extreme position to the right or to the left. 4 claims.

CORRESPONDENCE.

Who Invented Magnetic Needles and Insulated Wire.

Your journal circulates so widely that I marvel at not yet receiving a solution to the above queries, which appeared in your issue of 18th September, 1891. Curious enough the only notice taken of the matter comes from America; but both attempts at a reply deal *only* with the question of insulation. To my mind that is the least interesting of the two, although both are links of value. May I therefore be permitted through your valuable columns to appeal once again to the world-wide electrical students to whom it goes, as a welcome visitor, from week to week and month to month, and especially to those whom the sea divides from its head-quarters—London.

Samuel Vyle.

Demerara, *December 28th*, 1891.

Mr. Perrin Maycock's Right-Hand Rules.

Referring to the article by Mr. Maycock, "On New Right-Hand and other Rules," which appeared in your columns last week, I should like to remark that the rules which Mr. Maycock has drawn up are deductions from those to be found in Jamieson's Elementary Manual on "Magnetism and Electricity," at pp. 83, 85, 120, and in Munro and Jamieson's Electrical Pocket-Book, at pages 371 to 374. Throughout, Mr. Maycock simply uses the direction of the right-hand thumb to indicate the direction of current, and the fingers to indicate the direction of field. In other words he has just turned the hand in Jamieson's right and left-hand rules through 90 degrees. May those be called "new rules"? and are they at all worthy to be published in a paper such as the ELECTRICAL REVIEW? The striking similarity between the two sets of rules, is made especially evident by comparing fig. 5, p. 66, ELECTRICAL REVIEW, with the fig. on page 372 of Munro and Jamieson's Pocket-Book.

David M. McLeod.

Parsons Steam Turbines.

We were interested in Prof. Ewing's report on the above. Some years ago we put up a large resistance (40 ohms) of *very* open iron wire spirals, for the purpose of testing alternating current dynamos. From careful experiments we found that the current passing, as measured by a Siemens electro-dynamometer, multiplied by the E.M.F. measured by a Cardew voltmeter, did not represent the electrical horse-power being given out. Indicator diagrams taken from engine showed that less horse-power was indicated in the cylinders than that in the external circuit, calculated as above.

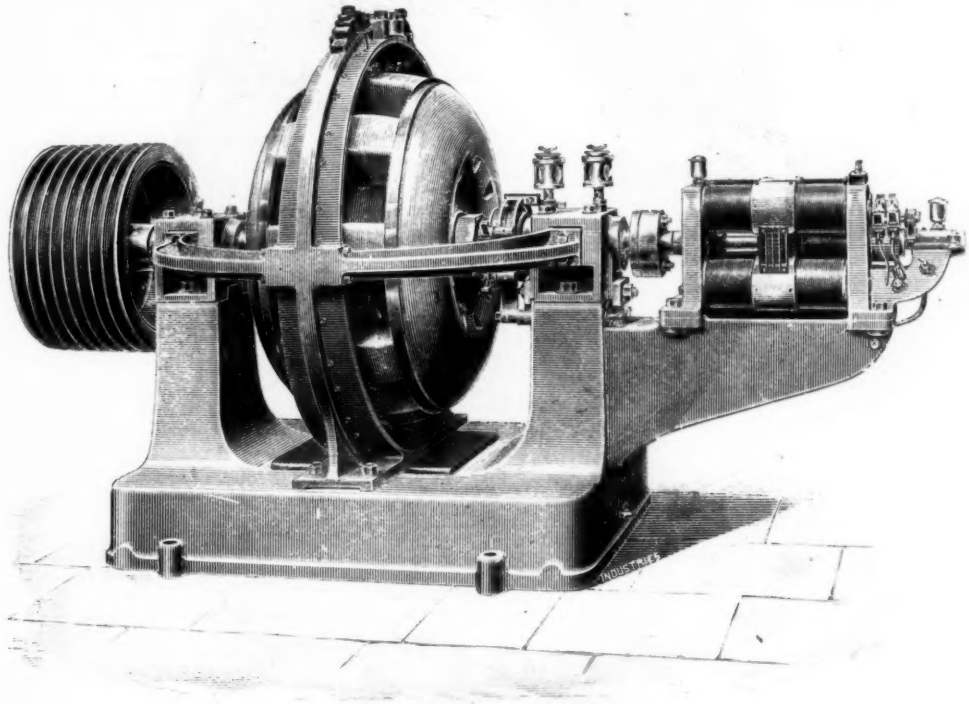
The Electric Construction Corporation, Limited.
T. PARKER, *Chief Engineer and Head Manager.*

January 19th, 1892.

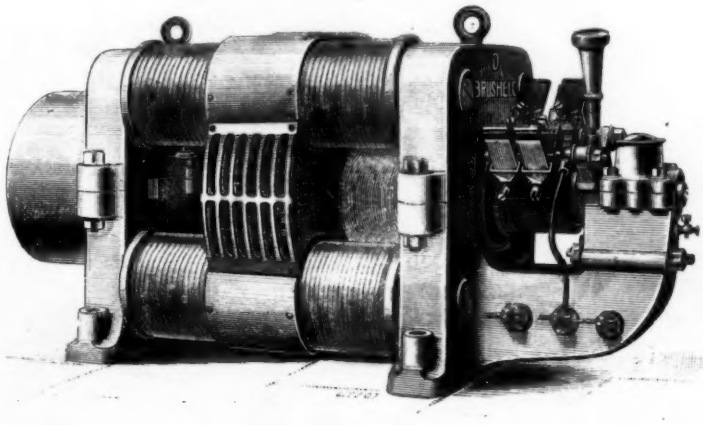
CRYSTAL PALACE ELECTRICAL EXHIBITION, 1892.

ALTHOUGH it might appear at the first glance that little progress had been made during the past week in completing the stands, much has really been done. Of primary importance is the fact that many of the stalls have now a supply of current, and with two or three exceptions the exhibits in the north and south naves have been placed in their positions. In the galleries, however, a great deal has to be done before any accurate notion can be formed of the special exhibits placed there. Of the machinery room we are better able to form an opinion than we were a week ago, and although this department is by no means remarkable for the order, in as much as only half of the machines are fixed, amid the chaos we see a faint indication of the scheme which is to be followed out in fixing the dynamos, gas engines, steam engines and the like. Of the exhibition, as a whole, having regard to the backward state of things, it is perhaps too early to form a fair opinion. But we can safely say that there will not be the compactness and completeness which marked the exhibition held two years ago in Edinburgh. Perhaps if that exhibition had never been held, the one at the Crystal Palace would have been more representative, for, no doubt, the absence of some large firms may be attributed to the unsuccessful results attending the exhibition of Edinburgh.

Since the exhibition is one mainly devoted to showing the progress of electric lighting during the past decade, it is reasonable to infer that dynamos for lighting purposes form the most important, and perhaps one of the most interesting departments in the exhibition. As the opportunity for dealing with these dynamos collectively has never occurred before and may never happen again, we shall endeavour to bring as close together as circumstances will allow, the peculiarities of each machine. To aid in this we shall illustrate where possible. It must not be understood that we are taking upon ourselves at the present moment the task of dealing in an exhaustive manner with the various types; the endeavour is simply one of pointing out new features, which struck us in a tour round the machinery hall.



MORDEY-VICTORIA ALTERNATOR.



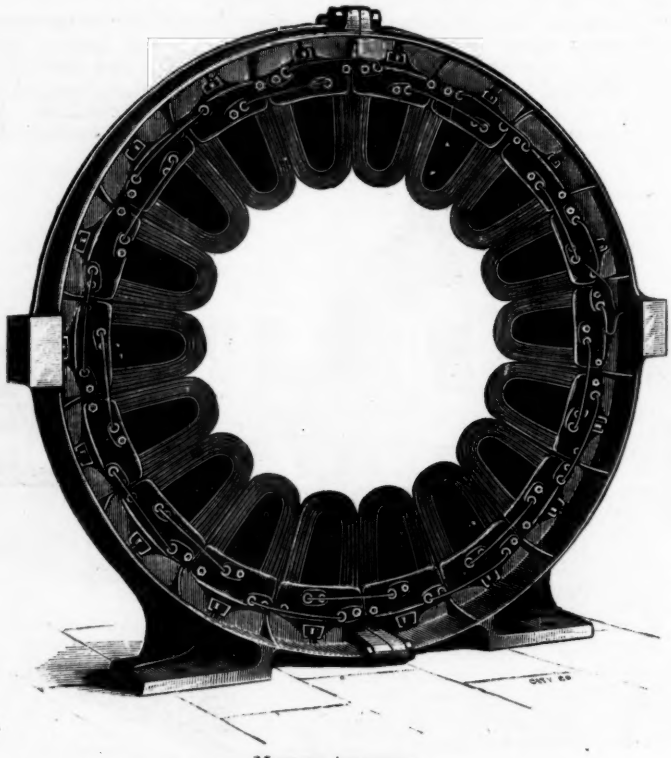
VICTORIA DYNAMO.

Some of the Dynamos.

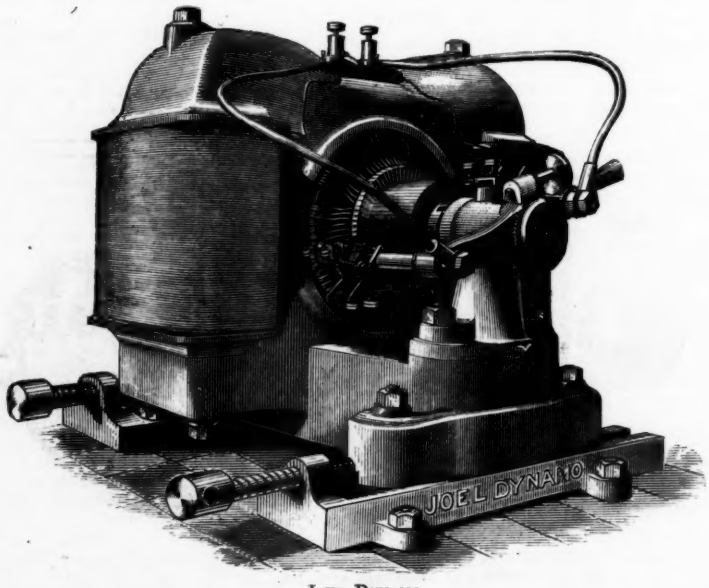
We do not pretend to describe the dynamos in their order of excellence, for, as the newspaper man says, "where all were so good it would be invidious to make comparisons."

The dynamos shown by the Brush Company are a noteworthy feature of the exhibit. In the machine room is the Mordey-Victoria alternator of 100 kilowatts driven by a Brush compound high pressure vertical steam engine of 280 I.H.P. Another Brush engine of 75 I.H.P. drives a Brush arc lighter of 55 2,000-arc lamp capacity. Near this stands a Victoria dynamo for arc lighting, which we illustrate.

Combined plants for use in private houses and on board ships are shown in various sizes both in the machine room and in the nave. Perhaps one of the most interesting exhibits in the nave is the latest form of Mordey-Victoria alternator; of course the general construction of the machine is too well known to be recapitulated here, but since it was last described there have been a few improvements made. As shown in the figure the exciter is coupled on to the machine; another new arrangement is the brushes, which are now made of fine wire gauze and hang loose on the commutator. The armature ring is different from those which have hitherto been made, ebonite caps are used at the ends of the armature coils. In addition an improved method of winding the cores is employed. A large family of Brush machines are on exhibition in the south nave. We believe it is the intention to run these, as well as the combined plants, when the necessary conductors have been made. We are by no means doing adequate justice to the Brush Company's exhibits in describing only the dynamos, for there are many other interesting exhibits, which, however, must be mentioned in another article. Perhaps we might here notice that motors will be working during the exhibition. A small Victoria motor will drive a 60-inch Blackman air



MORDEY ARMATURE.



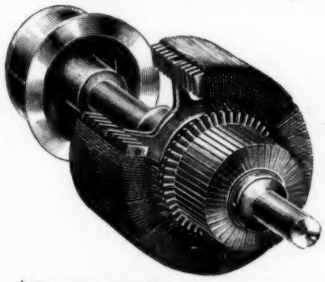
JOEL DYNAMO.

propeller, and a larger motor driving a quartz crushing machine made by the Sandycroft Foundry and Engine Company.

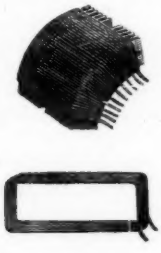
Although Messrs. Woodhouse and Rawson take no prominent part in the machinery room, a large stand in the north nave is fairly representative of their many manufactures. The Kingdon dynamo, which was illustrated and described by us on March 20th, 1891, is on the stand. We illustrate the Cornbrook dynamo which is also shown on this stand.

We illustrate the latest type of the dynamo manufactured by Messrs. Joel, which is exhibited. The bearing arms carrying the axle are cone-shaped and hollow; they serve the purpose of waste oil receivers, a tap being provided to draw off the waste oil; the rounded surfaces not permitting any accumulation of dust. The bearings are very long, being at the pulley end four times the diameter of the axle, and are arranged with oil channels at each end, so that the oil does not splash but runs into the reservoir. The poles are of cast iron, shaped to obtain the greatest magnetic efficiency, and are also of rounded form; the field cores are of the very best hammered scrap wrought iron, annealed. The commutator is exceptionally large, and the segments are made of special metal for great durablility. One of the features of the machine is that the brush holder can be easily and quickly taken off for cleaning and adjustment. The brushes are fitted with pointers to show their position, and with adjustable spiral springs for contact pressure, as well as stops to keep them off the commutators.

We also show the complete armature and the armature and commutator with segment of coils removed (showing pulley on end of axle), and a figure representing segment of coils from armature and single armature coil. The armature is built up of sections or groups of laminated iron plates of segmental shape. These sections interlock, fit into each other, and are fastened by bolts to spokes, and thus form the rim of the wheel. The insulated wire coils are separately wound, and are threaded on the core sections. The ends of the coils are connected in a special and convenient manner to the commutator, and can be quickly disconnected.

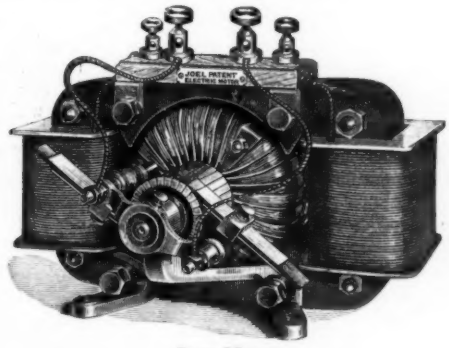


ARMATURE AND COMMUTATOR WITH SEGMENT OF COILS REMOVED.



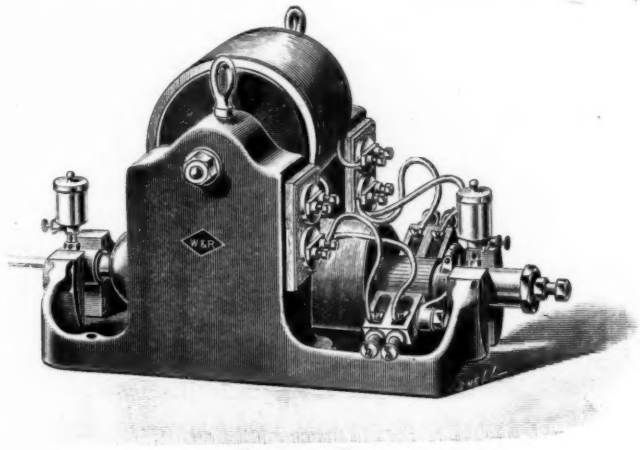
SEGMENT OF COILS FROM ARMATURE AND SINGLE ARMATURE COILS.

The mechanical details are worked out to secure great simplicity, and to enable the dynamo to be easily and quickly taken to pieces and put together again without special skilled labour. This is useful on board ship, in the country, and other places where an easily-repaired machine is necessary. For use on board ship a spare set of armature coils is provided, in the event of damage by steam, water, or any unavoidable cause, such as is frequently the case owing to the cramped space usually available for the electric light machinery; the engineers can then easily repair the machine and put in the new coils if necessary. The machine has a compact appearance, whilst all the working parts can be easily examined. It is said a great number of these machines are in practical everyday use, often running 24 hours at a time, and there are many testimonials as to their good qualities.



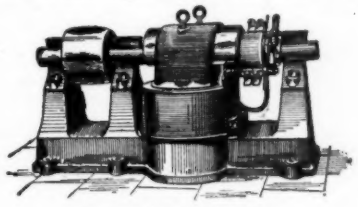
JOEL MOTOR.

The Joel motor is also at the Exhibition. These are made to run with either continuous or alternating currents.

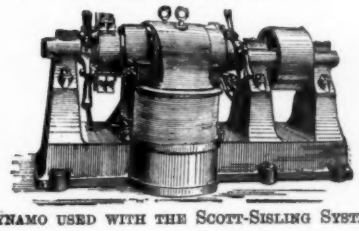


CORNBROOK DYNAMO.

The special feature of the motor is the use of very thin laminated iron in the fields and armature. The field magnet cores and poles are made in one piece of thin stampings of iron of the exact size and shape, and any number of these (according to the size required) are bolted together and thus



NORWICH D TYPE DYNAMO.



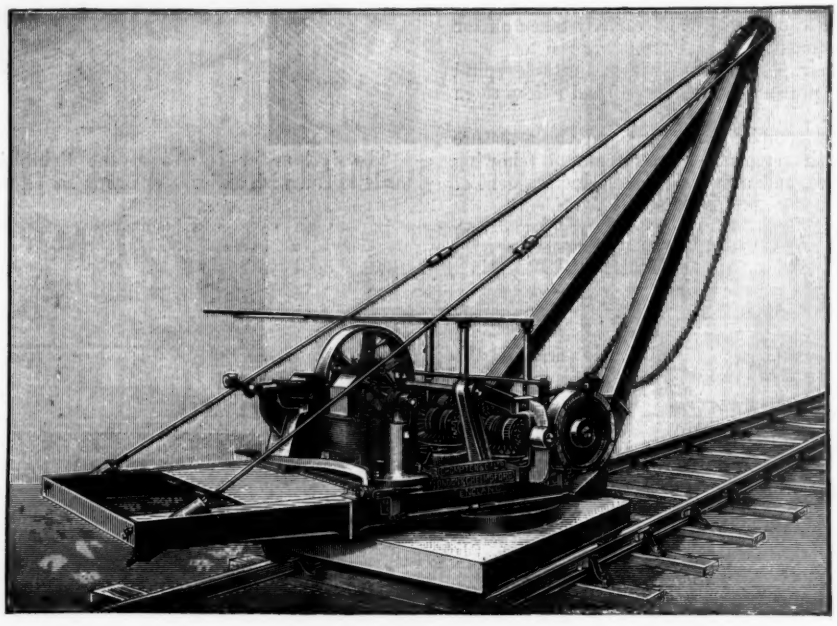
DYNAMO USED WITH THE SCOTT-SISLING SYSTEM.

make up the iron frame without any after tooling, and having the greatest possible magnetic efficiency. A number

of these motors have been made and supplied, and from exhaustive tests are stated to give an efficiency of 90 to 92 per cent.

There is no special exhibit of the Norwich dynamo at the exhibition, but it is seen at work in connection with the model country house installation fitted on the Scott-Sisling accumulator system, by Messrs. Barclay & Co. The exhibit comprises a 6 H.P. Stockport gas engine, driving a 4-unit Norwich dynamo, and a battery of 44 portable accumulators, cells of E.P.S. type, 15 H.P. each. We illustrate the Norwich dynamo, and the same machine fitted with the extra commutator for the Scott-Sisling system.

We illustrate here a Crompton's electric crane, which is driven by a 5-unit motor, taking 45 amperes and 110 volts. It is stated to hoist two tons at the rate of 80 feet per second. The motor is connected by a friction wheel to an intermediate shaft, which is connected by a spur-wheel to the drum shaft. This latter contains a clutch to throw the drum in or out of gear. A powerful band brake is provided on the drum and is worked by a treadle. The slewing is done by intermediate gearing from the intermediate shaft, and is controlled by a hand lever conveniently placed. The crane is made to travel by the movement of a hand wheel in a manner similar to that by which the operation of slewing is carried out. It is fitted with Crompton's patent sight-feed lubricators, and all the latest improvements. Current is supplied to the crane by two rails, along which are laid copper strips. The rails are carried on Crompton insulators similar to those used in his underground mains, and are laid between the travelling rails. The current is taken off by an improved form of collector gearing with carbon brushes. A double-pole switch and fuse are interpolated in the circuit. The crane will be exhibited at work at certain stated times during the exhibition.



CROMPTON'S ELECTRICAL CRANE.

We give here Siemens's magneto-electric mine exploder which requires no explanation.

IT is stated that at the close of the exhibition the railway companies will convey any unsold exhibits to London or other places on their systems, free of charge.

WE are informed that the beautiful showcase which Messrs. Rashleigh Phipps and Dawson have made for their display at the Crystal Palace Exhibition, in the form of a mosque at Cairo, was specially designed and manufactured by them, and at the close of the exhibition will be for sale.

THE backward state of the exhibition has caused a good deal of grumbling on the part of the public. It would naturally be disappointing to a person, relying on the advertisements and Press notices, to make a special journey down to the Palace, more particularly in the case of a man coming from the country and whose time is limited.

THE Crystal Palace Electric Light Company starts its career well. The whole of the output is at present taken up by the exhibitors in the Palace; it is said that private customers will be unable to obtain current before the close of the exhibition.

ONE only learns from experience how badly the catalogue of the exhibition is arranged. It is impossible, when looking under any particular section, to find any adequate description of any firm's exhibits.

WE notice that overhead wires play a too obtrusive part in the Exhibition. We should have thought that electrical firms would have been alive to the necessity of eliminating from their exhibits anything unsightly.

IT is said that the Crystal Palace Company will supply no less than 150,000 incandescent lamps to the various stands and exhibits. Of course the exhibit of the Edison-Swan Company is responsible for a good many of these.

MESSRS. ANDREWS & PREECE have appointed Mr. Cecil Wray as their London representative during the exhibition.

IT must not be understood that we have by any means exhausted the types of dynamos which are shown at the exhibition. We shall endeavour, however, to continue our description next week.